July 1973

Smithsonian

Rowland Emett's fanciful drawings are made into objects (p.34). Here he is in his Hush-a-Bye hot air rocker

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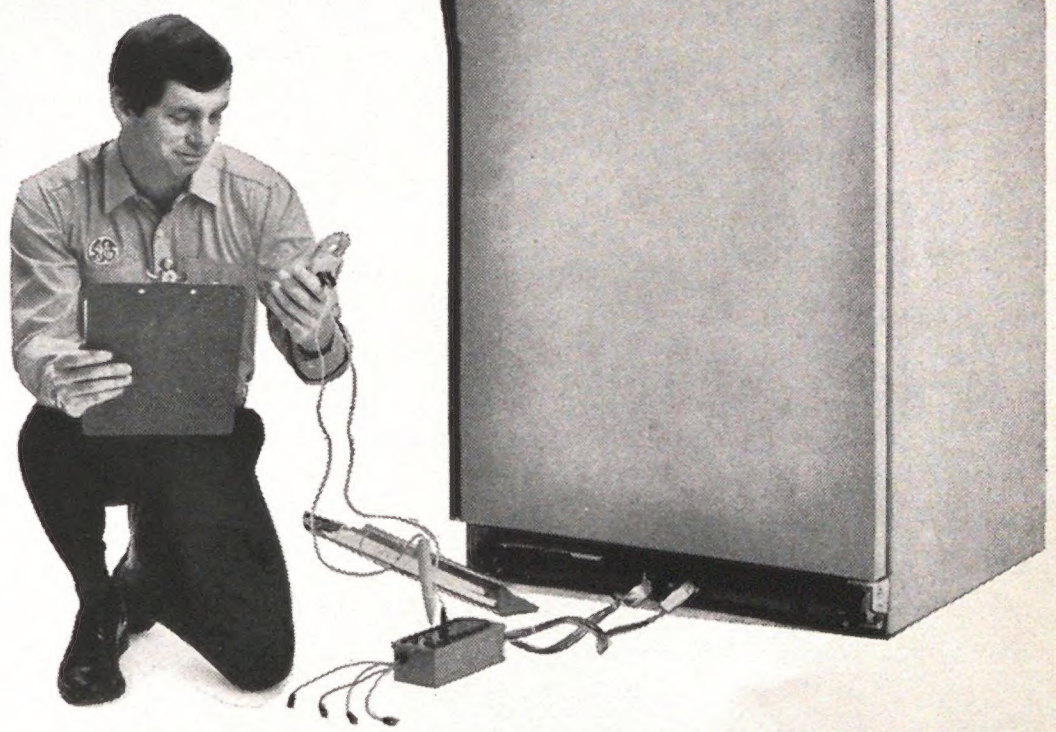
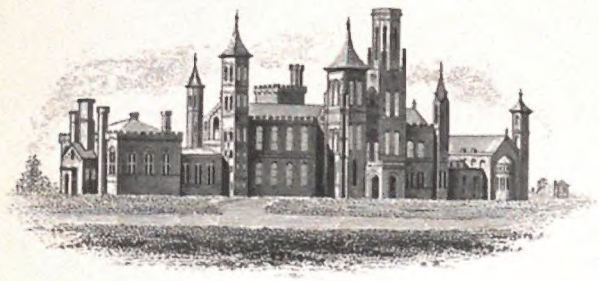


GENERAL ELECTRIC

Secretary Ripley's comments

The view from the castle



I had not been long at the Smithsonian when I attended one of those affairs which take up large portions of the life of every museum. Someone was giving us a rare specimen for exhibition. President Johnson was on his way to help acknowledge the gift.

Time dragged on and no President. I had a plane to catch. Finally I turned to Chief Justice Warren, then Chancellor of our Board of Regents. "What can I do, Mr. Chancellor? I have to leave, but I can't be rude. Stay or go?" The Chief Justice looked at me, twinkling: "Don't worry, Mr. Secretary. Just run along. I'll mind the store."

Since my coming to the Smithsonian, a source of strength has been having three former Secretaries of the Institution very much at hand. Charles G. Abbot, my antepenultimate predecessor, who still works regularly, was born in 1872—within the first century of the Republic. He began at the Smithsonian in the 1890s as an assistant to Samuel P. Langley, the third Secretary. Langley and his successor, Dr. Charles Walcott, died in office.

But from Abbot's term on, beginning in 1928, we are all here. Dr. Alexander Wetmore served as Secretary from 1945 to 1952. Dr. Leonard Carmichael served from 1953 to 1964 and, like the others, still keeps up his research interests. I started minding the store in 1964. It has certainly been much more fun having these other active and vital gentlemen around than if I had had to go it alone.

As we approach the end of the second century of the Republic, I cherish the sense of continuity. The store is bigger and more complicated than ever, but so are the stakes. The responsibility for cultural and scientific enlightenment, the needs of our disparate public, and the maintenance of a tradition of curatorial scholarship and conservation are more urgent. The educational role of the Smithsonian today carries a compulsion that it might not have had in the 19th century. I'm proud that there are four of us down at the store.

Leonard Carmichael

S. Dillon Ripley Charles Greeley Abbot Alexander Wetmore

Photographed at the 50th anniversary of the Freer Gallery of Art by Margaret Thomas—The Washington Post

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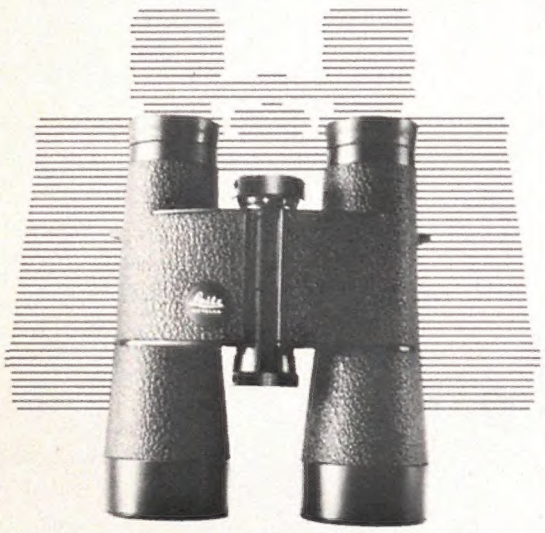

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Phenomena, comment and notes

A crisis in yams, a nearby glitch, mercy sought for the crown-of-thorns, and kittens, stripes and ghosts

For a few years now, scientists on both sides of the Atlantic have been raising kittens in environments where they have nothing to look at but stripes of a single orientation (that is, their entire visual world consists of vertical stripes or horizontal ones) for the first few months of their lives. The researchers have found that kittens raised on vertical stripes have great difficulty perceiving the world of horizontal detail (and vice versa) when it finally confronts them. Apparently neurons in the visual cortex that were intended to respond to horizontal things become responsive only to vertical things (and again, vice versa). The conversion is largely irrevocable.

The utility of this information may seem restricted unless, for some reason or another, you do not want your cat to notice any nearby herds of zebras, but the implications for humans are, in fact, beginning to come clear.

For example, a number of people have difficulty resolving either horizontal or vertical detail. Such people are also astigmatic, and this particular part of an astigmatic's problem cannot be corrected by lenses. Two California optometrists, Ralph D. Freeman and Larry N. Thibos, present evidence in *Science* that the problem is the same for astigmatically prone children as for kittens—a neurophysiological one, resulting from "the lack of exposure to well-defined stimuli" in either the vertical or horizontal planes early in life. The optometrists provide no recommendations, but certainly such findings may one day influence the decoration of nurseries and perhaps even preschool classrooms.

It does not stop there, however. One of the early experimenters once wrote: "Maybe the general inability to perceive ghosts, flying saucers, and so on, could even be partly due to a failure in our nervous systems!"

The yam crisis

The demand for a kind of yam may be exceeding the supply, and that is a more serious problem than it sounds at first. The reason is that these yams are (so far) the most convenient source of diosgenin, a natural steroid compound upon which the oral contraceptive depends. Worse, these yams have never been commercially cultivated—it takes some 20 years to produce a crop of diosgenin-rich yams, so that a wild species from Mexico continues as the main, if dwindling, source. "In effect," writes the *New Scientist* bluntly, "the carefree fornication of the Western World depends on the foraging of primitive tribesmen."

As in the energy crisis, a search is on for alternative sources. The Russians are trying to cultivate two related species that are fairly abundant in Australia where they are known as "kangaroo apples." Ecuadorians have found a plant with a particularly rich supply of the coveted ingredient—but unhappily the plant is a tall tree covered with thorns and it grows in the relatively inaccessible headwaters of the Amazon. The answer may come in the form of a yellow, tomato-sized fruit that grows widely in the high Andean plain of Ecuador and labors under two unfortunate common names: "dog poison" and "poor man's soap." But even this hopeful sign leaves the question: Should we be dependent on a foreign nation for so important a resource?

A glitch close to home

You almost certainly did not notice it, but your life—and everyone else's on Earth—was recently affected by something called a glitch. Not a character invented by Dr. Seuss, a glitch is a term also used by astronomers and astronauts. It de-

scribes a change in the rate of spin of a pulsar (see p. 54 for another aspect of these recently discovered phenomena). In this case, however, the glitch was earthly.

The spin of the Earth is known to be slowing down (thus the days are lengthening); indeed, the spin is slowing at an accelerated rate. This is no cause for immediate alarm. It will be thousands of years before we have a perceptibly longer day. But in August 1972 there was an abrupt, temporary (and also quite infinitesimal) increase in the rate of slowing. Writing in *Nature,* John Gribbin of that magazine's staff and Stephen Plagemann of the National Aeronautics and Space Administration attribute the glitch to a particularly violent outburst of solar flares that happened to have occurred in the same month.

They admit the connection is not altogether clear—it is known that solar flare storms increase the flux of cosmic rays, which in turn affect the Earth's magnetosphere and outer atmosphere. It has also been calculated that weather can affect the rate of the Earth's spin: The wind, for example, slows or speeds the Earth's spin ever so slightly depending on which way it blows.

Somewhere between the realm of the weather and that of the outer atmosphere there must be some kind of connection, but it remains to be discovered. The two scientists are nonetheless convinced that the glitch and the solar storms are cause and effect, and they are now seeking other effects, such as an increase in earthquakes.

Animal oracles

Speaking of earthquakes, there is a body of folk science which suggests that animals can predict them, along with volcanic eruptions. The most prescient animals, according to the *Field Museum of Natural History Bulletin,* seem to be dogs, horses, pheasants and seabirds. In many reported instances, seconds before humans felt the first shock of an earthquake or volcanic eruption, dogs have barked, shivered and acted queerly in general, horses have whinnied and stampeded, cats have bolted, pheasants have crowed and seagulls have flown inland.

Investigating the 1968 eruption of Mt. Arenal in Costa Rica, Smithsonian geologist Tom Simkin "reported hearing that cattle moved down off that volcano just before it erupted. This surprise erup-

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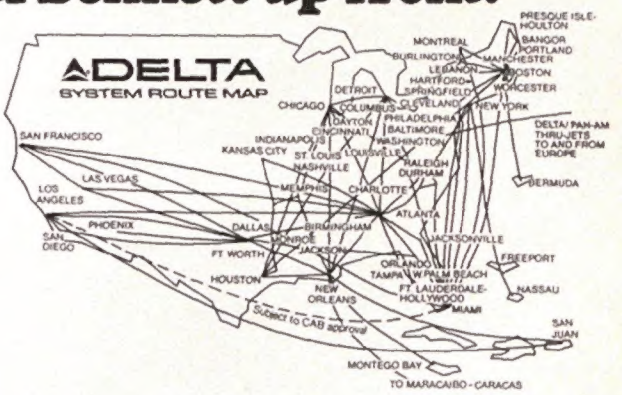

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tion was the first for Arenal in about 400 years." Cats and rats have also been known to get restless before quakes.

It could be, according to most scientists who have thought about it at all, that sometimes some animals do notice the small foreshocks to which people are insensitive. It might also be a response to changes in air pressure or electric or magnetic field, or to high frequency sounds from rocks grinding.

In any event, not all such catastrophes are presaged by unusual animal behavior. This seems to be an area where one should place his faith in geophysicists (who claim they are on the verge of being able to predict earthquakes, if not volcanic eruptions, by themselves) rather than on old Fido—who won't give you more than a few seconds warning anyway.

On the other hand, the *Bulletin* reports that the People's Republic of China is taking no chances. Their new earthquake-prediction program combines the activities of physicists with animal-watching peasant volunteers.

Exonerating the crown-of-thorns

Remember the crown-of-thorns, that villainous, oversized starfish that underwent a population explosion in the 1960s, and began to devour coral reefs in Australia and Guam? No one was sure at the time why it was appearing in such numbers—perhaps because its only identifiable natural enemy, a mollusk called the triton, was being over-hunted by men who wanted its pretty shell. Regardless, the general feeling was: "Never mind, let's get rid of that starfish before we lose our reefs" (See SMITHSONIAN, April 1970). Bounties were put on the crown-of-thorns throughout the Pacific and thousands upon thousands were destroyed.

Now a Smithsonian biologist, Peter W. Glynn of the Tropical Research Institute in Panama, reports that the starfish may not be such a threat after all. He says it only eats the edges of the living coral reefs. And in *BioScience*, J. M. Branham of the University of Utah writes that the starfish population may not have exploded at all—it may simply be that in the 1960s more people began snooping around reefs, and thus more people began noticing the crown-of-thorns because it was designated a threat. It is possible, he says, that the starfish is simply one of several natural ways that coral-reef

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growth has always been limited. In any case, both scientists say the wise course now would be to halt extensive eradication programs, except in those few locales where the starfish is provably hurting a reef.

Apollo rediscovered

You might think that by now astronomers would be able to keep close track of all the objects in the solar system, but it is not so. There are a number of small asteroids, familiar enough to bear names, which have been missing for some time.

One of these has just been found. It is Apollo, one of a group of asteroids that swing very close to Earth every so often. (Icarus, for example, caused all sorts of dire predictions among the less cool when it passed a mere four million miles from Earth in 1968.) Missing for 41 years, Apollo was recently observed by Richard McCrosky and Jerome Shao at the Smithsonian Astrophysical Observatory. Another, named Hermes, came even closer than Icarus in 1937 but is now lost again, and so also, said the astronomers without a twinge of embarrassment, is Adonis.

Merchandising instinct

The sport of hunting is an emotional issue. There are those who find it morally repulsive as well as ecologically unnecessary; others see it as a crucial element in wildlife conservation, and unavoidable anyway because Man is prehistorically and instinctively a hunter. To just what levels of refinement the pursuit of this instinct can lead us is to be learned in a recent article about the Y. O. Ranch by Roger Rapoport in *Harper's* magazine.

Formerly a Texas cattle ranch, the Y.O. is now the largest private hunting ground in the United States. The owner offers "guaranteed hunting with confidence . . . that killing game at his ranch is about as easy as shooting fish in a barrel —perhaps a little easier." Not only native deer but exotic game animals from four continents are available on a "no kill, no pay" basis. The hunters exercise their age-old instinct by pursuing trophies from guide-driven vehicles (thus saving long hours that would be otherwise wasted in useless stalking), and the ranch spares them the mess of skinning and even the bother of finding a taxidermist.

Rapoport quotes a guide as saying: "In

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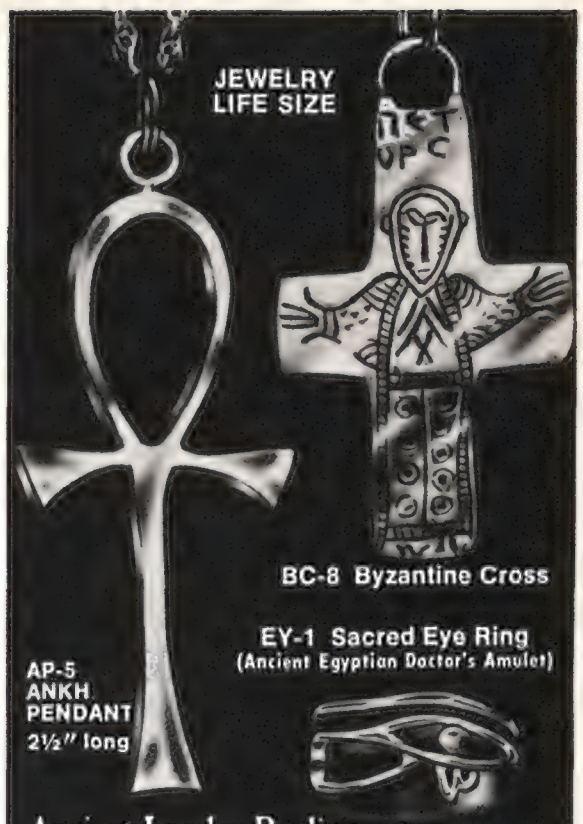

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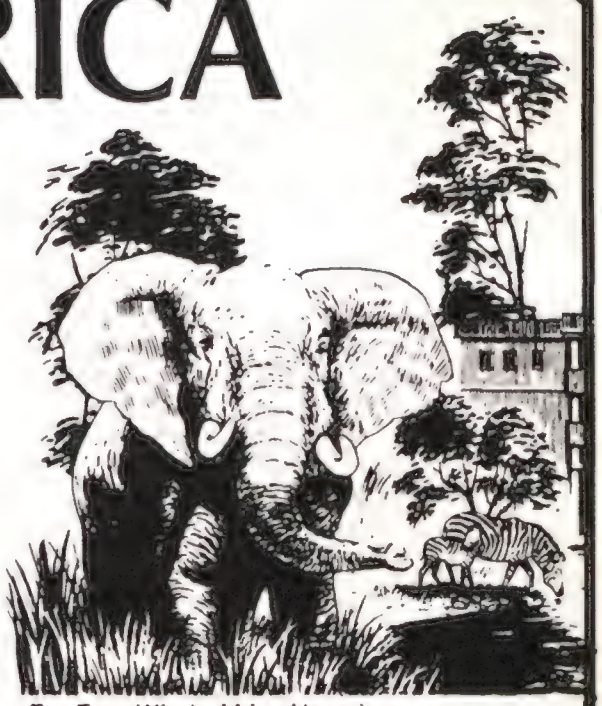

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their native countries of Pakistan and India, blackbucks are so rare and endangered they can't be hunted. But here at our ranch the $750 blackbucks are on sale for $500 as part of the Y.O.'s Christmas Special." Indeed, the ranch abounds with a variety of rare and endangered species which are very successfully bred and raised on the premises as trophies to be pursued and shot.

Not all stock or activities, Y.O. says, are for mere sport and profit. The Y.O., along with other Texas ranches, has "shipped small blackbuck herds back to Pakistan and India for repopulation." Not only that, but "every year, nearby service clubs round up 100 orphans and bring them out to shoot their first doe for free. The boys hunt Y.O. does early in the morning and then come in for a special church service . . . everyone on the ranch believes that hunting builds character in young people."

At least, anyone *on* the ranch who *doesn't* believe it had better keep it to himself. Others may speak out.

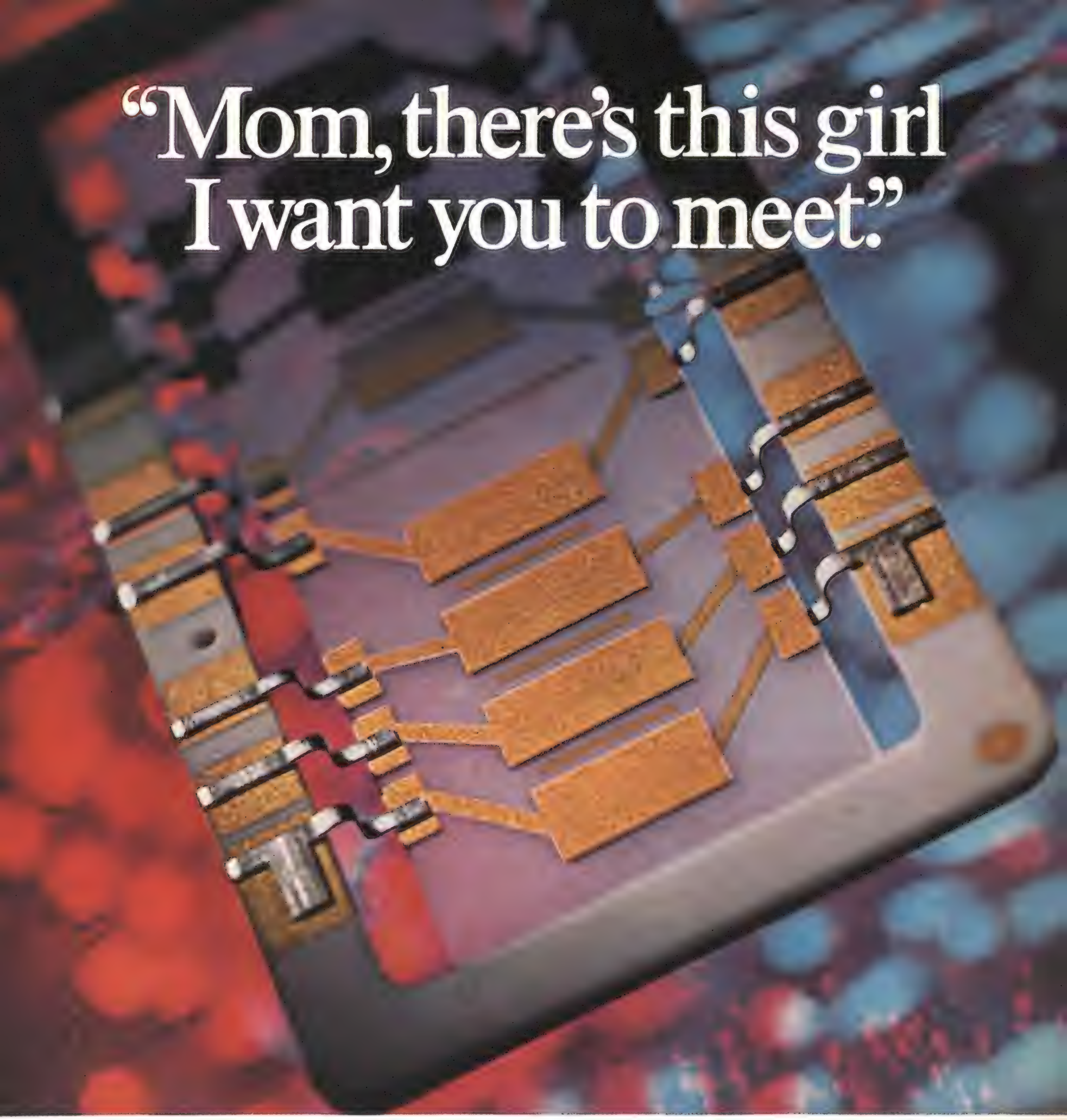
The eagle tree

Anyone who ran into a natural history museum claiming to have just seen a flock of passenger pigeons would risk being put away for good. One who reported seeing a treeful of bald eagles might get the same kind of treatment—but unfairly. For that is just what photographer Vic Banks of Chicago saw and photographed in West Glacier, Montana (right).

These were northern bald eagles, of which there are some 6,000 to 11,000 left, mostly in Alaska. (There are hardly enough of the *southern* bald eagles left to fill up a tree: some 300 nesting pairs from Chesapeake Bay to California, according to the U.S. Fish and Wildlife Service.)

The northern bald eagles congregate on a lake near West Glacier each winter in pursuit of landlocked kokanee salmon. The birds apparently fly in from British Columbia and, after the salmon have spawned, leave for parts southeast. While Mr. Banks' photograph is a comforting sight, it should be borne in mind that the Park Service counted only 287 migrants at peak time at the lake last winter, down from the 1969 record of 373.

Bald eagles, like Christmas tree ornaments, in a tree at West Glacier, Montana.



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Letters to the Editor

Lake Mascoma

Dear Sir: When you had available that breathtakingly beautiful photograph of Lake Mascoma on the opening pages of your article in the May issue, "Troubles brew below a lake's shining surface," why did you put that revolting picture of the half-naked blacksmith on the cover?
Cecilia Werner
New York City

Dear Sir: Your May cover was refreshing, upbeat, and a welcome change from jewels, birds and biplanes.
Marilou Taylor Vaughan
Santa Monica, California

Dear Sir: I am much disappointed to see you degenerate to sex appeal.

As a boy, 60 years and more ago, I loved to watch the blacksmith work at his anvil and bench. I am sure I never saw him without a shirt.
Theodore L. Bissell
Hyattsville, Maryland

Dear Sir: Don't tell me a magazine of your caliber is going the way of all flesh!
Patricia W. Calvo
Cleveland, Ohio

Dear Sir: The cover is absolutely revolting, whether or not it was chosen as an attention-arrester to get people to read the article.
Nellye Newton Archambeault
Chicago, Illinois

Dear Sir: We were most impressed by your article on the pollution problems of Lake Mascoma. Author Hugh Moffett and photographer Carl Mydans did a magna cum laude job.
Ralph H. Morse
Department of Resources and Economic Development, State of New Hampshire
Concord, New Hampshire
Tastes vary. Some readers did not like the cover. It was considered a dramatic picture, however, and was intended to call attention to the article on Lake Mascoma's pollution problems. That even the protesters turned to the article is evident. SMITHSONIAN *has found that a national problem is understood better if we deal with the specifics of a given situation rather than generalities.* Ed.

Dear Sir: Unlike "The Village Blacksmith," the shirtless man on your cover does not seem to have muscles as "strong as iron bands." Also, I think the Longfellow hero would have pulled on a shirt before posing for a cover picture.
Mary Peabody
Hancock, New Hampshire
Since Longfellow wasn't very accurate about Paul Revere (See April SMITHSONIAN*), perhaps he was not describing the typical village blacksmith in his poem.* Ed.

Man and technology

Dear Sir: Sir Peter Medawar's delightful article on evolution and technology comes at just the right moment in mankind's history, not only to inspire hope in the midst of darkness but to indicate in what direction salvation may be sought. Unquestionably, technology will be the indispensable ladder, a "new technology . . . founded on ecology."

The major characteristic of the new ecology is not a drop in the temperature as it was during the last ice age, or a vast flooding of the Earth as it was for Noah, but a world suddenly overfilled by technologically sophisticated, selfish and environment-changing human beings. What we face is the need of a technology for *compacted social existence.* Among the new "tools" required are population limitation, social and political ethics and a decent regard for the needs and rights of others. No one must be misled into thinking that solutions can be found in science alone—they can come only from the purposeful acts of man.
Luther Gulick
Institute of Public Administration
New York City

Do 18th century things have a place in our century?

From the 18th and 19th centuries come the warm and beautiful designs in furnishings, tools and accessories that are working a new revolution in the quality of life of twentieth century man. Read here how the Early American Society can help you bring the beauty of early America into your family's life.

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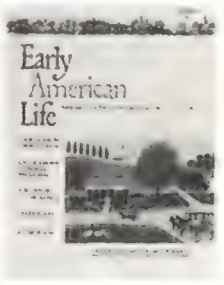

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Dear Sir: Remember that it was the combination of technology and the dollar that caused our present problems. Smokestacks, cars, planes, detergents and DDT are all products of technology, and all are ruining the world's natural balance.

Machines have gotten us into this mess, and only humanity can get us out.
Brad Artson
San Francisco, California

Dear Sir: In your technology article, there is a remarkable similarity between the last illustration and the famous cabin scene in Charlie Chaplin's *Gold Rush*.
James F. McMullan
Philadelphia, Pennsylvania
The similarity was intentional. Illustrator Robert Osborn says he "absolutely had that great scene in mind." Ed.

Travels with medicine man

Dear Sir: Medicine man John Lame Deer's wisdom, wit and warmth are, indeed, unforgettable. But author Richard Erdoes' recollection of our conversation varies from my own.

Lame Deer asked me if I believed that animals could enter heaven. Also, did I believe that animals and plants are our relatives, and do they have souls?

I responded that I had been trained as a priest both in the church's sacred ways and in the Cheyenne sacred ways—and that I believed that both were one and true. I also stated that the Cheyenne belief that sacred spirits may assume the forms of men, animals, birds and plants was not different from the church's teaching. The church believes that angels are pure spirits—but when they appear to human beings, they assume human form, just as Cheyenne's sacred spirits do.

It was after I had said all this that Lame Deer responded: "It's all right. We won't tell your bishop."

I have just sent a copy of this letter, plus the SMITHSONIAN article to my bishop —and I'm sure he will enjoy both.
The Reverend Dr. Peter J. Powell
St. Augustine's Center
Chicago, Illinois

Shakespeare festivals

Dear Sir: Your article "Cross-country with Shakespeare" was outstanding in every respect but one—your photograph of the scene from *Troilus and Cressida* was not from a performance at Washington's Sylvan Theatre but from the Oregon Shakespearean Festival in Ashland.
Robert F. Knoll
Oregon Shakespearean Festival
Ashland, Oregon
Mr. Knoll is correct. Ed.

Phenomena, comment and notes

Dear Sir: Although the trilobite you picture, which is *Phacops rana,* has fossil eyes through which scientists can peer, its lips evidently have remained sealed—or else it would have loudly complained about your adding some 120 million years to its age. *Phacops rana* is a mid-Devonian index fossil of about 380 million years, not 500 million.

As members of the "Society for the Protection of Aging Trilobites," we protest.
Julian Kane, Elizabeth MacQueen and *Ray Scully*
Garden City, New York
Although there are trilobites 500 million years old, the one in the photograph is Phacops rana*—380 million years old.* Ed.

Dear Sir: In your April issue, you referred to our work on the preservation of early mouse embryos by freezing. There are other important implications: The technique will facilitate studies on the biochemistry of early development, perhaps leading to more effective contraceptives and even to the development of more productive livestock in converting feed to meat.
Peter Mazur
Biology Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee

USSR's French paintings

Dear Sir: Having just visited the Russian exhibition of French paintings, I think I spotted an error in your article in the April issue. In Cezanne's *Study of Bathers,* I remember the tree as being on the left side of the painting; your photograph showed it on the right.
Jill Gillespie
East Lansing, Michigan
Miss Gillespie is correct. Our article had to go to press before the paintings arrived in this country, so there was no possibility of checking against the pictures themselves. Unfortunately, our copy of the painting was mislabeled. Ed.

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By Walter Angst

Heraldic plan for redesign of the state flags

The prescription may be a mountain goat
rampant *or a bull's head* caboshed Or,
but the cure is a flag you can tell at a glance

Outside the Smithsonian's Museum of History and Technology, in Washington, D.C., 54 flags flutter almost every day (opposite page). One is the national flag, another the Institution's emblem and the others represent the states, the District of Columbia and Puerto Rico. We recognize the first two. But many of us Americans have a good deal of trouble distinguishing our own state flags.

Sometimes this is due to our own ignorance or indifference. All too often it is because the flags fail to identify themselves. Flapping languidly in a vagrant puff of urban air, the majority of them remain indistinct. This is a call to redesign state flags according to heraldic principles.

There was a time when being able to distinguish one flag from another could be a question of life and death.

Put yourself back in time 600 years and imagine that you are on watch from a tower of your lord's castle. In the distance you see the dust of approaching horsemen and, above, a dancing speck of color. You know that this is the armorial banner of a knight banneret—a family flag—but you don't know whom it represents. You can distinguish red, white, black and a little yellow, but you cannot yet make out the heraldic charge, the device emblazoned on the fluttering piece of cloth.

Enemy or visiting dignitary? A call to arms or to the master of festivities? If you don't make up your mind quickly, your life's not worth a plugged farthing, so you shout down to the keep for your lord's herald to come up and identify the banner. He knows what today is called vexillology, the science of flags. In 1373, when family connections were often a man's most valuable resource, flags were designed to tell at a glance and at a distance what head of a family was there. Heralds, respected in peace, inviolate in war, could interpret the colors and devices that symbolized a family's history and genealogy. A flag could tell a herald instantly how powerful and rich its owner was. The flag of a local sovereign—in most instances developed from an original family banner, and later often evolved into the flag of a national state—showed territorial possessions, political influence and war potentials, hence the importance of the party to be received at the castle.

The science of flags has sadly declined since 1373. Of all those 50 state flags outside the Museum of History and Technology, only a few—Maryland, Colorado, Hawaii, New Mexico, the District of Columbia and perhaps four Southern states—can be recognized easily. Most of the others are those familiar vexillological atrocities consisting of a small disk centered on what is often a field of blue. Strictly speaking, these are not flags at all, but misused state seals. Mix them all up to destroy the order (usually alphabetical) in which they appear, and often not even their own state politicians would know the difference.

A flag should be designed with certain established principles in mind. The simpler its design, the better it is. In heraldry, which is the basis for vexillology, a flag's symbolism was expressed either by a "canting" design—a play on the surname—or by alluding pictorially to some family situation, peculiarity or special deed. Colors were distinct, arranged in stark contrasts of warm and cold, dark and light, with easily legible figures, stylized and exaggerated in their characteristic forms. The divisions of the field obeyed heraldic rules based on the need for maximum visibility and immediate identification.

These principles still hold good. A flag depicting a coat of arms correctly consists of the shield only, which is compressed into a square or rectangle, and the charges in it may be distorted so they fill the available space boldly. This is called an armorial banner. It contains none of the devices surrounding the shield—helmet, crest, supporters, motto, mantling—because to include these additions would reduce the shield and its charges in size, which defeats the purpose of the flag: easy identification.

Just as important, a good flag never has any writing on it: If a flag flutters in the wind, writing is hard to

The author, Swiss born, is one of our few American experts in matters of heraldry. He is conservator at the Smithsonian and is writing a book on heraldry.

read. If it hangs limp, lettering cannot be deciphered at all. A clear, simple design is all the legend needed.

It is wholly inappropriate for a state flag, which is supposed to convey uncomplicated symbolism, to have its two sides differ from each other. This ambivalence is reserved for a parade flag—and then only when unavoidable. Such a flag is fastened with rings so it can be twirled around its staff.

It is often unnecessary to translate the whole of the design of a complicated coat of arms, or of a seal, into a flag. Many times, simple color combinations suffice, provided they are arranged correctly. Note that the arms of the town of Limburg in the Netherlands contain five elements: three quarters consisting of a lion rampant, one of hunting horns and in the inescutcheon another lion rampant. But the Limburg flag makes do with only one lion rampant on white, blue and gold.

Heraldic colors, metals and special color combinations used to denote furs are called tinctures. A proper flag should observe the so-called tincture rule: Tincture should never be put on tincture. Color should not be put on color, nor metal—gold or silver—upon metal. Two dark or two light colors, or two warms or two colds should not be put side by side. It is obvious that a green design on a blue field, or a light blue on a dark blue, or a white on a yellow are much less visible than a dark blue on yellow, a white on deep red or a bright yellow on green.

In the ancient language of heraldry, which is as precise as a chemical formula, the metals and colors that over the centuries have proved most effective are *Or* (gold, hence yellow), *argent* (silver, hence white), *gules* (red), *azure* (blue), *vert,* (green), *purpure* (purple), *sable* (black). A *proper* is the actual color of an animal or item, chosen as close to a heraldic tincture as possible. Pastels and neutral colors are unsuitable because they are too hard to distinguish from a distance.

Let us take our one example of a perfect state flag—Maryland's (p. 25). It is an armorial banner, the shield of the Calvert family, who were the colony's proprietors. It consists of quarters, the Calvert family in the first and fourth quarters, the Crossland family, to which Lord Baltimore's mother belonged, in the second and third quarters. The field of the first and fourth quarters is divided into six vertical sections alternating gold and black, hence it is termed *paly of six Or and sable.* Over this goes a diagonal stripe, a *bend,* divided into six countercolored *pales.* The field of the second and third quarters is itself quartered (*argent and gules*) and is charged with one of heraldry's scores of crosses, this one a *cross botonny.* The cross is also quartered and countercolored.

This good flag shouts at you with its blazing colors: "Hey, look at me! I am Maryland! Am I not pretty? Follow me!" It makes no sense that the flags of roughly half of our states and territories cannot be distinguished because they consist of seals or similar devices on a plain blue field which look alike when they fly high on a staff. Take just four which occur in alphabetical order: Kansas, Kentucky, Louisiana, Maine. All four are blue; their charges are only barely distinguishable from one another. Here is how, under the rules of heraldry, they could be improved:

The Kansas seal consists of a busy landscape—a wagon train crossing the plains, coming from a river

Arms of the town of Limburg in the Netherlands (opposite) have been simplified to fill its flag (above), becoming *Per fess argent and Or, a fess azure, over all a lion rampant doubletailed and crowned gules.*

with a steamboat and passing a herd of buffalo being chased by Indians, while in the foreground a farmer plows near his cabin; behind him the sun rises above a mountain range, although the sky is full of stars.

Let us take one component of all this and create a meaningful and effective flag. Try a stylized covered wagon under a sky with the 34 stars that denote the states of the Union when Kansas joined. The blazon (technical description) of this flag is: *azure, a covered wagon argent, body and spokes gules, the port sable, in chief 34 (12, 11, 8, 3) mullets of five points silver, and in base debruising the wagon's body a campfire issuant Or* (a dictionary helps!).

Kentucky also sports its state seal—two friends clasping hands and grasping each other's shoulders. Originally, these were depicted as hunters, but their clothing has changed over the years. Instead of trying to show the pair, I first tried to charge the flag with two "faithful" (clasped) hands. I discarded it in favor of interlaced hearts on a silver roundel, or *plate.* These express the same meaning—"United we stand, divided we fall." Hence: *azure, on a plate two hearts, one reversed, both voided and interlaced gules.*

There is nothing wrong with Louisiana's flag except that its charge, the pelican, is rendered incorrectly and much too small. The bird should be depicted with eagle's wings, a long neck and no pouch, "vulning" herself, that is, drawing blood from her breast to feed her young. This is a very ancient symbol of piety, self-sacrifice, motherhood and Christian virtue. Now increase the size of the charge to fill the space, and you have: *Azure, a pelican in her piety argent, armed Or, the nest and beaks of the three young ones gules.*

Maine has a landscape with a pine tree as the main charge in its shield—as usual, much too small. To make a correct flag would require landscape, tree, reclining moose, meadow, forest, sky and water all spread over the flag—a tiresome and unnecessary hodgepodge. We don't need a whole landscape to recognize the Pine Tree State. Instead, let us take the state flower, a pine cone, stylize it and fill the space thus: *Argent and in the sinister flank azure, a pine cone bendwise gules.* If Maine felt very strongly about retaining its gold star, we could put it on the blue flank of the flag, but it's supposed to depict the North Star, indicating that this is the most northerly state. Since this is no longer true, it is meaningless.

Vermont's flag is now almost a duplicate of Maine's. To display its coat of arms correctly, the flag should be yellow. Then the mountain range, stylized as a "fess wavy," can be green to fit the state name, literally "green mountain." The present tree is a pine, but it would be better to make it red so two greens would not interfere with each other. Since the state tree is a sugar maple, which turns bright red in the fall, the problem is solved. If Vermonters insist that their cow stay on the flag, it could be reduced to *a bull's head caboshed.*

Flags of the South rank high

Most Southern states have flags which are distinct and easily recognizable. They were created with the purpose of expressing strong emotions. Florida, however, looks just like Alabama except for its seal, which is too small to be seen properly. So why not make a canting flag for Florida—a play on the name? Change the indistinguishable seal into a stylized flower—a white orange blossom (the state flower).

Nevada has a barely visible small white star in the first quadrant of a blue field (which is often rendered in a pale blue), accompanied by two nondescript green sprigs and a yellow scroll with illegible writing. *This* is recognizable as Nevada? Instead, let us put a small white star on a blue star in a gold canton, along with the sprigs of sagebrush, and with a minimal change we have at least made Nevada's flag recognizable, even when it is hanging limp.

Several states have resorted to printing their names on their flags so that people will know what they stand for. This, of course, breaks a cardinal rule of vexillology, and could have been avoided by simply improving their flag designs.

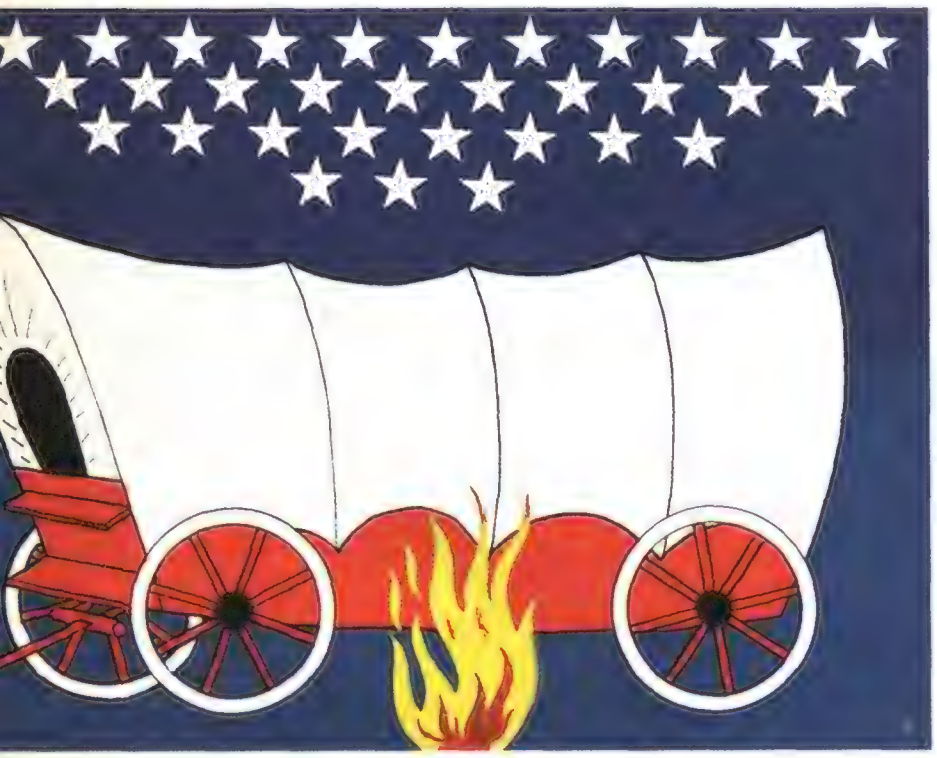
California has a basically good flag design, but it is

drawn so small that the state name has been added to clear up the identification problem. The name takes away space that should have been used for expanding the design, the walking bear. Once the bear is made heraldically correct—stylized, space-filling—and ferocious, instead of the tame zoo bear he is now, the flag will be recognized.

Most of the seals misused as the charge in our state flags consist of landscapes. It is fine to represent a landscape on an actual seal used on a document, but if we place it on a flag we should spread it out to fill the space and stylize it to make it recognizable. Take New York's shield: the sun rising behind a mountain range that borders a busy harbor, with a green meadow in the foreground. Simplified and heraldically stylized, it could be translated into a forceful flag that would look quite different (p. 24). The new blazon: *Per fess wavy Or and argent, in base three barrulets wavy*

Kansas, Kentucky, Louisiana and Maine flags are neighbors (alphabetically) and yet are easily confused. Kansas' seal (above) could make a true flag (below).

Kentucky's seal and motto, lost in its blue field, could be made distinctive by turning it into a heraldic symbol for unity. The letters should go.



azure, in chief three mountains issuant from the partition vert, and a rising sun (without rays) gules.

A more abstract possibility lies in readjusting Montana's flag. Here again is an elaborate landscape with the sun shining over the Rockies, the Great Falls of the Missouri, the buffalo and other animals, a plow, shovel and pick. Instead of cramming all this into a stylized version to make a proper flag, we might try some different symbolism to convey the same meaning of Montana—"mountainous region."

The Rocky Mountain goat, an agile and freedom-loving climber, seems like a good subject to put on a mountain pinnacle and flood with the sun's rays (p. 25). This would be described as: *azure, a Rocky Mountain goat climant argent, armed Or, unguled and langued gules, on a triple-rock in dexter base Or, issuant from sinister chief a demi-sun radiant of nine straight rays, also Or*—unmistakably Montana's flag.

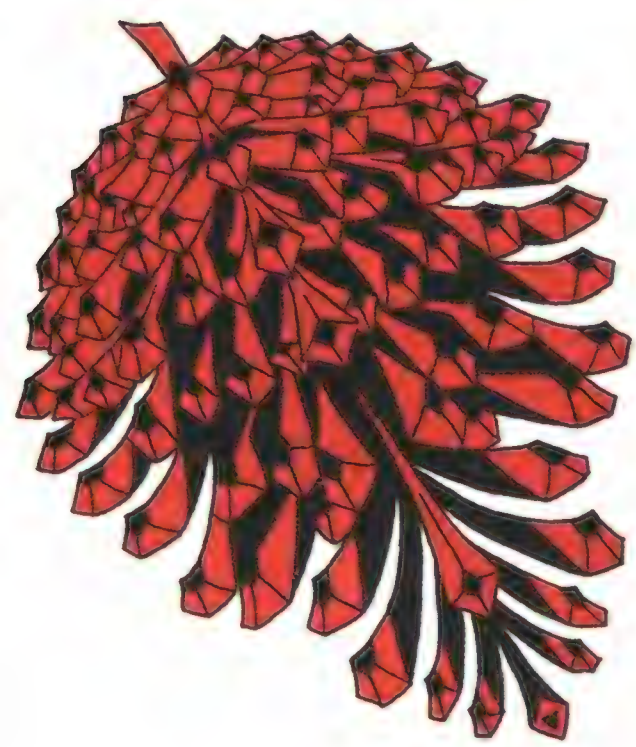
Symbolism has a broad horizon. Idaho's flag contains the state seal, so complicated and crowded that it loses meaning. The landscape part of it—a mountain range above a plain and a river—could easily be reduced to heraldic charges. But all the components tend to symbolize mining, justice and liberty. So an ancient symbol for silver (Idaho leads all the states in silver mining) could be balanced by the state flower, the syringa, and thus the flag would embody justice and liberty.

Using the rules of heraldry, our state flags could be made recognizable, yet beautiful, thus achieving more meaning and perhaps stirring a little pride in the breast of the beholder.

The approaching Bicentennial festivities will include many occasions on which all the state flags will be flown together. Let us show flags that can be recognized as symbolizing their states.

Just another seal-on-a-blue-field now marks Maine. Symbolizing the Pine Tree State with a cone, enlarged to fill the field, would make the flag stand out.

Louisiana's flag uses an ancient heraldic motif, a bird (here a pelican) *vulning* itself—drawing blood to feed its young. It needs to be much larger.

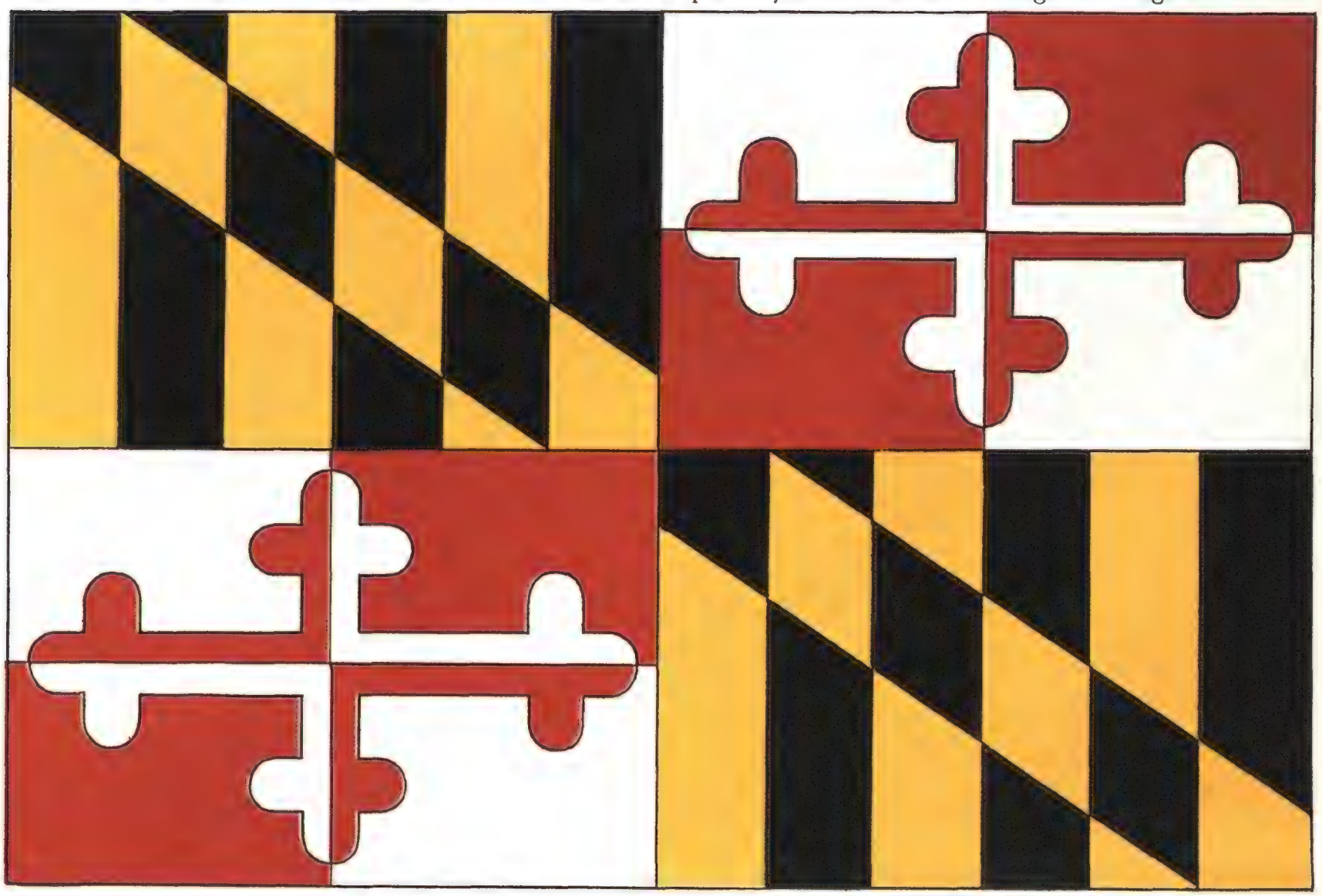


New York's landscape, now crammed in a shield,
should be expanded as above and stylized
according to heraldry to shout for attention.

One idea for Vermont—to please those who insist
on retaining the state seal's cow—is to stylize it
correctly as a bull's head *caboshed* (without neck).

Montana's flag, with its cluttered seal, calls for
a simpler and more spectacular treatment.
Heraldry's animals are fierce, mountains jagged.

Maryland's state flag is perfect—correctly adapted
from the shield of its colonial proprietors,
proudly rendered in bold design and bright colors.



Three young Asiatic lions cuddle in relative coolness
in the sun-dappled thickets of the Gir Sanctuary.

Text and photographs by Eliot Elisofon

The last of the Asiatic lions hang on in India's Gir forest sanctuary

Smithsonian-supported studies of the bizarre ecology of these predators has helped in managing—even stage-managing—their lives

There were about 20 of us, including several young children. A father held his daughter high up on his shoulder so that she could see. Her enormous black eyes were rimmed with tears as she watched seven lions stalk slowly up the dusty hill we stood upon.

The lions passed us by, intent on a black goat. The goat was led by a khaki-clad tracker called a shikari, who also carried a 12-gauge double-barreled shotgun. Wherever the goat went, the lions followed, sometimes as close as five yards behind, but the goat was safe so long as the guard was present.

This was the Lion Show, a performance held nearly every day late in the afternoon in the Gir forest in the state of Gujarat in northwestern India. Normally, the lions stay hidden from view deep inside the dense scrub that covers the Gir hills. Every morning shikaris go out and look for fresh pugmarks in the soft dirt of the sanctuary's roads; once they locate the lions, a decision is made where to hold the day's show. To have lions lured past tourists by uniformed guards may seem a bit stagy, a bit artificial, but given the denseness of the scrub, it is the only way tourists can see the lions of the Gir. And the Gir forest is the only place in the world where one can still see the Asiatic lion *(Panthera leo persica)* in its natural habitat. The Smithsonian Institution has had a long-standing interest in the Gir forest and its lions, so I went to India last January to look in on them.

The Asiatic lion is a subspecies, differing only slightly from the lion of Africa *(Panthera leo leo)*. According to Edward P. Gee in *The Wild Life of India,* the Asiatic lion has larger tail tassels, elbow tufts and belly fringes, and is longer in the head and a bit stockier. But peering through the thickets at the Asiatic lion one is likely to notice only that it has a smaller mane—perhaps, suggests Gee, a result of living in a hotter climate or perhaps because in colonial times when visiting VIPs were offered a lion to kill, they naturally preferred to shoot ones with big manes.

Originally the Asiatic lion ranged from Greece to central India, but by A.D. 100 it had disappeared from Europe for good. There are references to them in the Bible, but they were gone from the Holy Land by the time of the Crusades. They held their own in the remainder of their range until the use of firearms became widespread—by 1844 the only sizable population of Asiatic lions was to be found in the Gir hills, which were within the private lands of the nawab of the state of Junagadh. At that time, it has been said, there were only a dozen or so lions left, and thenceforth until Indian independence, the nawab and his descendants carefully protected this valuable component of their royal game from being exterminated.

In 1955 Prime Minister Nehru visited the Gir forest and observed what may have been the first lion show, watching from a tower since no one was certain how the lions would behave. Impressed, the Prime Minister recommended that a tourist industry be built up around the lions. By 1965 the area was reclassified from game reserve to wildlife sanctuary, and more than 5,000 tourists a year were watching much the same kind of lion show that I saw in January.

After their performance for me and the tourists, the lions did not get to eat the black goat (which would

Mr. Elisofon visited the lions of the Gir forest on his last round-the-world trip before his recent death.

scarcely be an hors d'oeuvre for a pride of seven lions) but neither were they turned away empty-handed. When the tourists had left and darkness fell, a water buffalo was left tethered to a tree as an offering. By morning all that was left was a meal for the forest's numerous crows. Many tourists would like to observe such a kill but this is discouraged by the government of Gujarat, a state in which the predominant religion (Jainism) forbids eating fish or meat.

But it is the nature of big cats to eat meat and so they are treated to tethered water buffalo by the government—only one of the ironies in the necessarily restricted, managed lives of these great predators. For another example, it has been suggested that thanks to the regular provision of water buffalo by humans, some young lions risk not learning to hunt wild game properly; at the same time, another threat to the lions' continued existence is that when they do make a more "natural" kill, it is often scavenged by humans! Nothing is simple in the Gir forest.

In its present state, the Gir is the largest wildlife sanctuary in India, spanning some 500 square miles of usually semiarid hills. Besides the cover of thorny scrub, the forest contains commercially exploited stands of small, crooked teak trees as well as acacia trees from which the small green leaves are nibbled by grazing animals. In fact, there are almost no green leaves to be seen except those on the banyan trees, those complicated structures of descending roots and ascending trunks that grow together in such a tangle that one does not know where they all began. The only bright color in the forest is the orange-red flowers of the Flame of the Forest tree. Unfortunately, during my visit the blossoms were covered with dust, as was everything else, because when I arrived Gujarat and the other northwestern states were suffering from the worst drought in ten years. Everything was bone-dry and the dust clouds that rose up behind us as we criss-crossed the area looked like wartime smoke screens.

There was little grass growing in the sanctuary this year, an ominous situation for the already hard-pressed populations of wild herbivores. The most common of these is the chital, or spotted deer (opposite page, at bottom), a beautiful but elusive animal found throughout the Indian subcontinent. Less common in the Gir are the sambar or large Asiatic deer, the nilgai or blue bull, and the rare four-horned antelope. Other wild prey species available to the Gir lions, as well as to leopards, jungle cats, hyenas and jackals, are wild boars and hares. One often sees langur monkeys feeding in the trees above the spotted deer; with the elaborately feathered peafowl, they serve as a mutual, tripartite warning system, alerting one another when a lion or leopard approaches. During my visit I saw only a few of these prey species, but even so—and choked with dust as I was most of the time—I got a sense of the dynamics of prey and predator as it must once have been in the Gir forest, but is no longer.

For the Gir forest is now grazed by thousands of domestic cattle, mostly water buffalo, and they consume much of the available fodder in the sanctuary. They are raised for milk, which is made into butter and ghee, the cash crop of the maldharis or graziers who have lived in the Gir since well before the turn of the century. Colorful, camel-riding people, they live in family groups in "nesses," clusters of low buildings; some 5,000 maldharis maintain more than 20,000 cattle in the sanctuary. In a normal year when there is no drought, an equal or greater number of cattle is herded into the sanctuary from elsewhere. Even more come in years of drought.

Competition from cattle

Cattle in a wildlife sanctuary make wildlife managers extremely uncomfortable. The cattle compete with wild herbivores and destroy the habitat. Predators, such as lions, become reduced in numbers or take to attacking the cattle, or both. In 1956, Lee Talbot, a Smithsonian ecologist who is now senior scientist on the President's Council on Environmental Quality, sounded the alarm over the destruction of the Gir habitat. A 1968 census showed a dramatic decline in lion numbers from an estimated 285 in 1963 to 177 in 1968. In that same year, sponsored by the Smithsonian Institution and the World Wildlife Fund, Dr. Paul Joslin of the University of Edinburgh joined other scientists in an ecological survey of the Gir forest.

Their findings were for the most part grim. Gir Sanctuary, reported Toby Hodd, a vegetation ecologist, exhibited overwhelming evidence of progressive and accelerating deterioration of the indigenous eco-

Leisurely stalking a goat led by a tracker, lions are tempted into the open for the benefit of tourists.

Less and less of a factor in the lions' diet, a chital pauses momentarily before bolting into the forest.

The last of the Asiatic lions

As one lion feeds, another appears sated. In the Gir's unnatural ecology, such meals are vital to the lions.

Three lions surround a dead buffalo, the "reward" they receive after performing in the daily lion show.

Lions attack and drag down a tethered water buffalo. Kills are seldom observed, except by officials.

system. Around its boundaries the sanctuary was being hemmed in by cultivated lands (and most of the lions which had inhabited the areas outside the sanctuary were gone); cultivation had spilled over into the sanctuary itself, where the habitat was already severely threatened by the maldharis' cattle.

By offering rewards, Joslin was able to get early word of lion kills and, from inspecting them and from the examination of lion droppings and other investigations, he proved what most people in the Gir forest already suspected—that is, the lions lived almost entirely on cattle. Apparently they had learned that it is relatively easy to kill a water buffalo, especially in the late afternoon when the animals are being driven home. The herders, carrying only sticks, have practically no means of preventing a lion from taking an animal from their herds. The maldharis value their milk buffalo highly, of course, and sometimes they keep a few milkless, cheaper cows or bullocks in the herd to satisfy the lions. Joslin found that the lions rarely kill a bullock, perhaps because it is too large for them, but cows were frequent prey.

Looked at from a different angle, this does not really seem to be a wholly unfair equation: a few cows and buffalo for some healthy lions. Furthermore, the government of Gujarat tries to compensate maldharis who lose cattle to lions. But it was not a fair equation, as it turned out, and it was the lions, not the maldharis, who were getting the worst of it.

In a report to the International Union for the Conservation of Nature and Natural Resources, Joslin wrote that the lions clearly did not reap the full fruits of their labor. "At least 23 percent of all carcasses

examined had no meat eaten from them, and fewer than 20 percent of carcasses had as much as 10 kilograms of meat utilized." Well over half the kills Joslin examined had been appropriated, or were about to be appropriated, by harijans—untouchables, most of whom live outside the sanctuary and who chase the lions off their kills so they can eat the meat and sell the hides. Thus we have what must be the least likely delivery system ever invented for a welfare program.

About the only thing going for the lions, it seemed, was the tourist business, inasmuch as the lion shows entailed bait. Joslin reported that more than 250 young buffalo were offered to the lions during the dry season in 1968-69 and none of these were taken by harijans; instead, the lions ate more than 10 kilograms of meat from each. With the help of Mr. Zafar Futehally, Honorable Secretary of the Bombay Natural History Society, I was given permission to photograph the buffalo being killed after the lion shows.

The lions are primarily nocturnal. They do not like to kill in the daylight. When the shikaris come along with an animal, the lions seem to know it is theirs and that there is no hurry. On one occasion I saw a full-grown lioness settle down next to a tethered young buffalo which continued grazing unperturbed—like a detail (albeit fleeting) from Edward Hicks' *The Peaceable Kingdom*. I saw two buffalo killed—or at least mauled before being eaten. The lion typically jumps on the buffalo from the back, hooking its front claws into the sides of the animal and bringing it down. On one night a pride of seven young lions attacked the tethered buffalo; one lion took it by the throat, dispatching it more quickly than usual. In this instance, there was no sign of the pecking order I had expected from observing African lions. An older female remained in the bush nearby; two males about a year-and-a-half old did not exercise their prerogative of eating first, and the larger females did not slap the younger ones away.

There are many who might, for a number of reasons, feel uncomfortable with the idea of sacrificing tethered animals in this manner. Yet I can say that the lions I saw were in prime condition; there were many litters and all the lions appeared well fed. Though the lions continue to kill both domestic cattle and some wild game, the bait is clearly an important ingredient in their well-being.

Well fed or not, however, the Gir lions' future is by no means a completely comfortable one. It is not even known for sure whether their numbers are increasing or decreasing. Indian officials are putting the new research into management practice, aware that managing the Gir Sanctuary is a sociological and economic problem as well as a biological one—and a long drought can exacerbate all such problems.

A number of positive steps have been taken already by the Gujarat government. The scavenging of lion kills has been outlawed in the sanctuary (although I saw a harijan and his young daughter skinning a two-day-old kill while the vultures waited nearby). Better accommodations for tourists are planned in the hopes that the tourist business will finally pay for itself. The cutting of teak will be discontinued. To keep graziers and cattle from entering the heart of the sanctuary from outside, a stone wall one meter high will be built around a large section of the forest; 75 kilometers of wall were erected in 1972. There is a plan to move the maldharis and their herds outside the sanctuary. They will be given land and compensation for moving.

Such measures may save the forest itself from extermination, but what they will do to the predators now living predominantly on domestic cattle is another question. The vegetation is expected to revive quickly, but it might take years for the wild herbivores to increase accordingly. And except for the buffalo offerings to the lions, the wild herbivores would be the sole provision for all the forest's big predators. It may well be that domestic cattle will have to be kept in the sanctuary, as in several game sanctuaries in Ceylon. There are signs of optimism: Plans are being discussed for reintroducing the Asiatic lion elsewhere in its former range, thus increasing its chances of survival.

In any event, it would appear that the last remaining Asiatic lions will have to be managed even more, and even more closely watched, before they can, if ever, be allowed to live more naturally and freely.

This old male, one of only about 200 Asiatic lions left in the world, stays deep in the forest as do all other grown males through the mating season.

By James Hicks

England's most fanciful inventor starts his own industrial revolution

Rowland Emett, a one-time cartoonist for Punch, *starts fulfilling his dream of a park composed of actual machines*

Rarely has the sanity of a public figure been so openly and persistently questioned as has that of Rowland Emett, the quiet, gentle Englishman who lives in Wild Goose Cottage, a rose-covered old dwelling as picturesque as its name in the village of Ditchling, Sussex. Journalists risk straining their own minds, not to mention Roget's *Thesaurus,* in search of terms adequate to their notion of Emett's mental condition. He has been called crazy, loony, potty, nutty, zany and the "majordomo of dottiness."

However facetiously intended, and however complimentary the articles in which they appear, Emett has begun to find such comments on his stability of mind boring. "People insist on calling me a zany inventor," he says with a soft voice and pained smile. "I am not zany, and I am not an inventor. I just create Things with a capital 'T.' "

Emett creates his Things on commission from big corporations for what he calls "quite immoral sums." And, in his own mild fashion, he cheerfully bites the hand that feeds him by gently mocking the sponsor's products. Financed by a Honeywell subsidiary, Emett's Forget-Me-Not Computer (built of bamboo in the shape of an elephant) blows a raspberry at the whole mystique of the electronic-brain business from which its sponsor makes its profits. It incorporates "the latest in solid-state design" (half a brick from a British stately home), a "card-punch unit" (of electrified woodpeckers), and can do almost anything except compute.

Similarly, his Vintage Car of the Future (opposite), which Borg-Warner commissioned, has "a great safety factor: It doesn't move. It does all its motoring in one place," which is hardly a conventional puff for the automobile industry.

One of Emett's ambitions is to see all of his creations assembled in one permanent, Emett-designed exhibition, preferably out of doors (see sketch, pp. 36-37). A park full of his Things is a delightful vision, but an expensive one. "I guess what I want is an angel, somebody to put up money and let me do just what I want." At present, Emett's creations are to be seen chiefly at commercial exhibitions and trade fairs, in convention hotel lobbies and department stores, anywhere their sponsors can exploit the amazing ability of his Things to pull crowds and garner attention from the press.

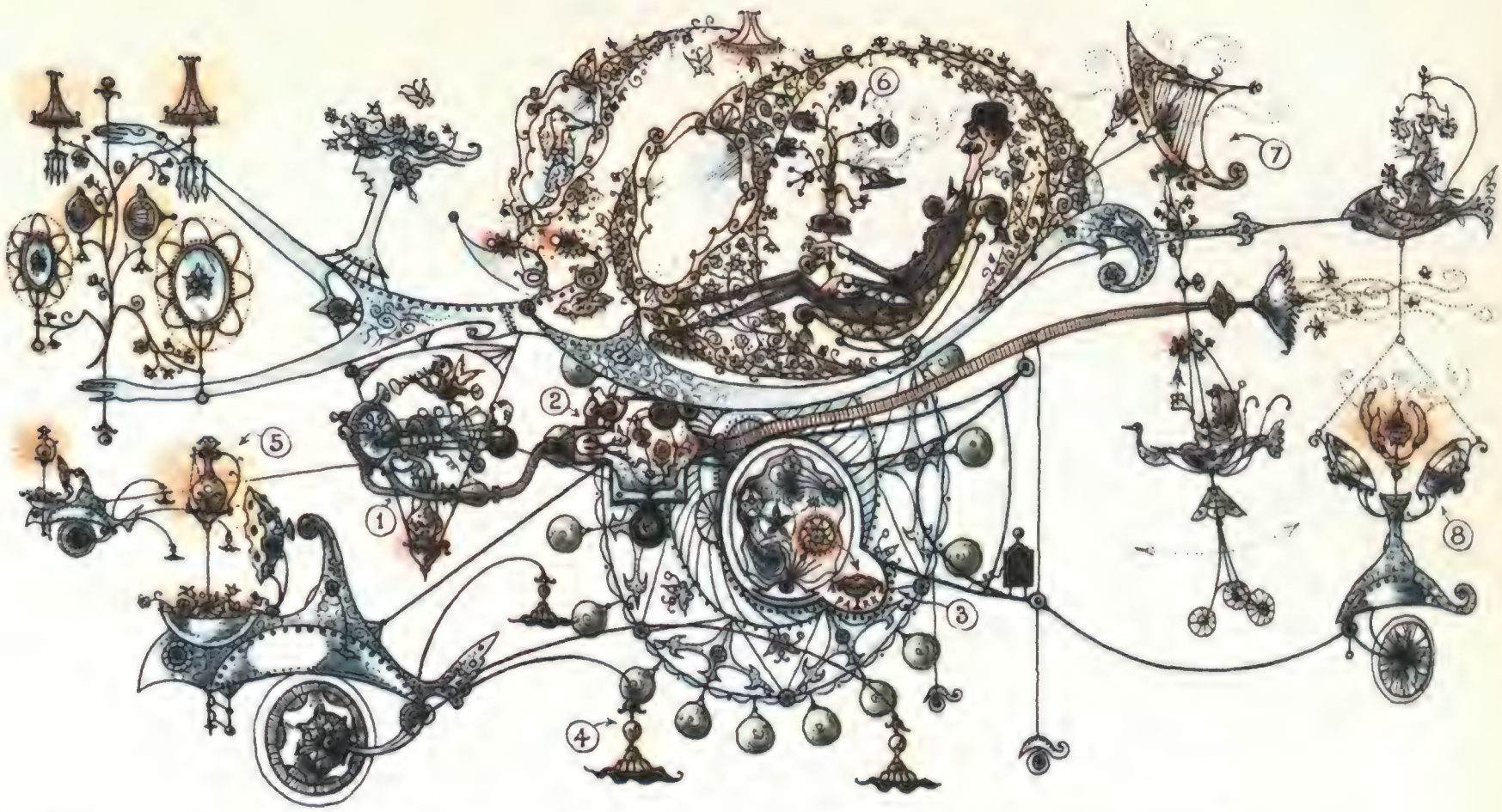
Rowland Emett began professional life in a commercial drafting office in England's industrial Midlands. In the Depression Thirties, fresh out of college where he had studied "ordinary art as it comes" and dreaming of a career as a painter, the young Emett found himself producing advertisement illustrations against the clock—"we usually had six hours to come up with something"—and grateful for the $15-a-week salary.

One day a workmate showed him an attempt at a humorous article he was submitting to *Punch* magazine. Emett thought it abysmal and was amazed when the piece was accepted for publication. He had never done a funny drawing in his life, but figured if *Punch* actually was paying money for such rubbish he might as well get some of it. So he dashed off a cartoon.

It was rejected. "The note said, 'Not quite, but very ingenious. Try again,' " he recalls. "I did, and got a $20 check. I thought, if I could get one of these every week

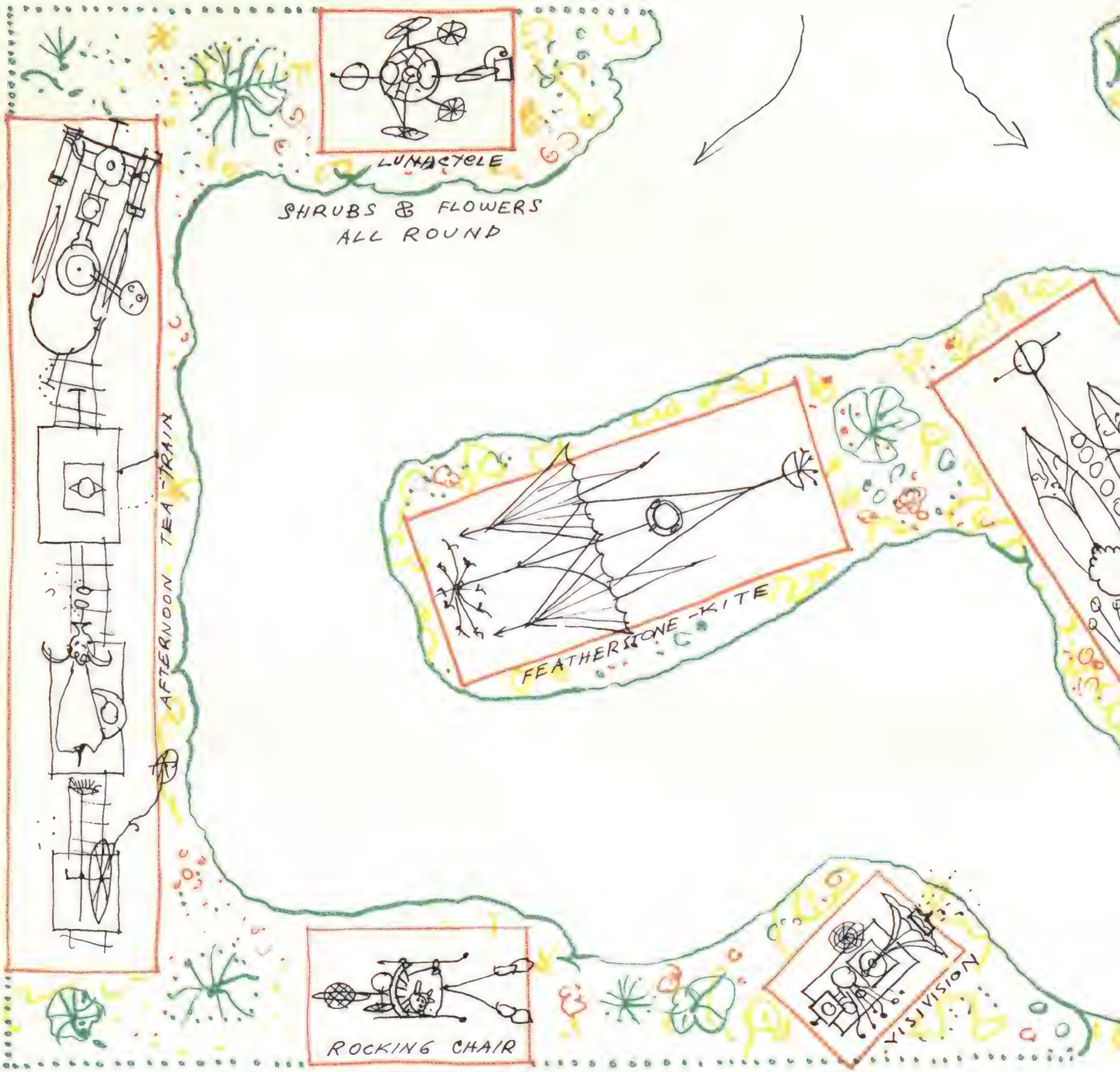
Mr. Hicks, an American journalist and novelist who lives in London, wrote on the English effort to save ladybugs (SMITHSONIAN, *February 1971*).

Drawings © Rowland Emett



The Vintage Car of the Future (above, as drawn in Emett's lacy graphic style and, below, as it appears in the United States) claims a couple of automotive firsts: It does not move and it produces "an effluent so pure that butterflies flock to the exhaust pipe." The numbered drawing points out (1) the power plant, (2) antipollution unit, (3) transmission, (4) brakes, (5) fog lamps made of cut-glass liqueur decanters, (6) control bouquet, (7) self-playing harp and (8) sausage barbecue to sustain the occupants during traffic jams.

Color photographs by Terence Spencer



Emett's dream is to create a permanent, preferably outdoor, display of all his merry three-dimensional contraptions. In this rough plan, he has placed two of his best-known nonmoving vehicles in the center (see upper right and preceding page) with other works placed around the edges. Spotlights will illuminate these machines.

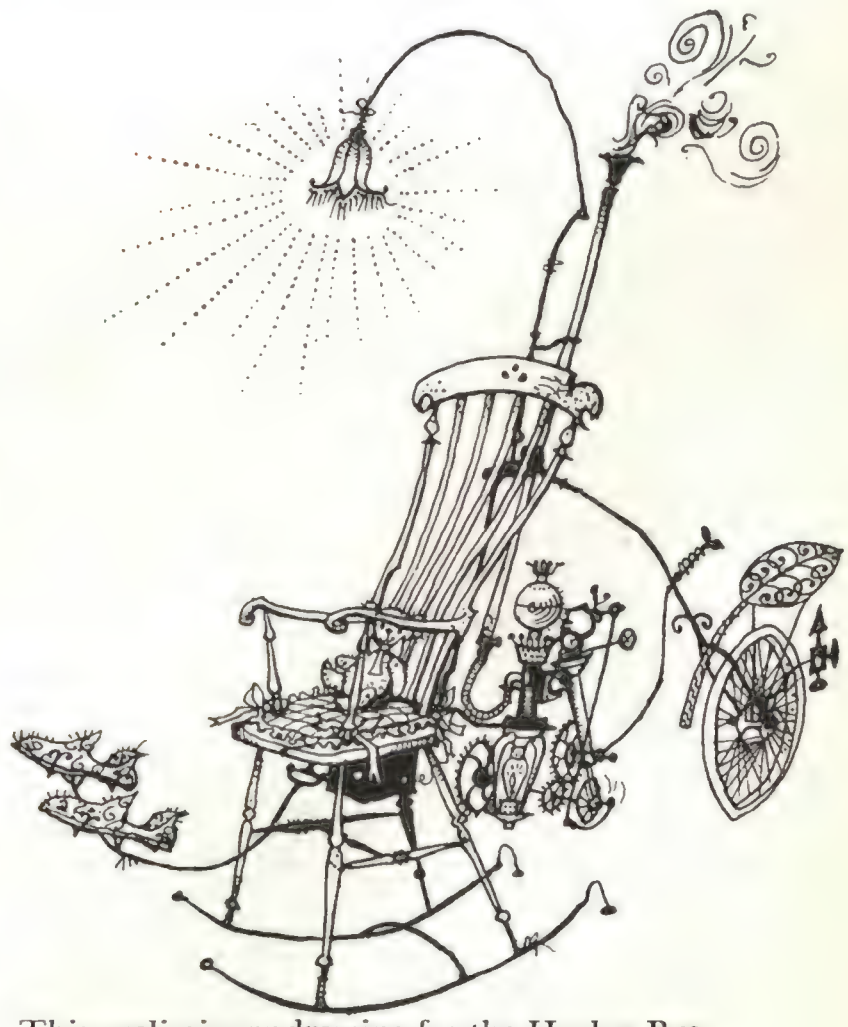
I would never have to do anything else but draw cartoons and paint." Within a few months *Punch* was carrying a half-page drawing by Emett in almost every issue, and soon began asking him to try his hand at full pages and color covers. During World War II a generation of *Punch* readers became familiar with Emett's light and lacy style and the outlandish wheeled contraptions which became his trademark.

While Emett was building an international reputation as a cartoonist, the British government, exercising a curious form of logic, drafted him into aircraft de-

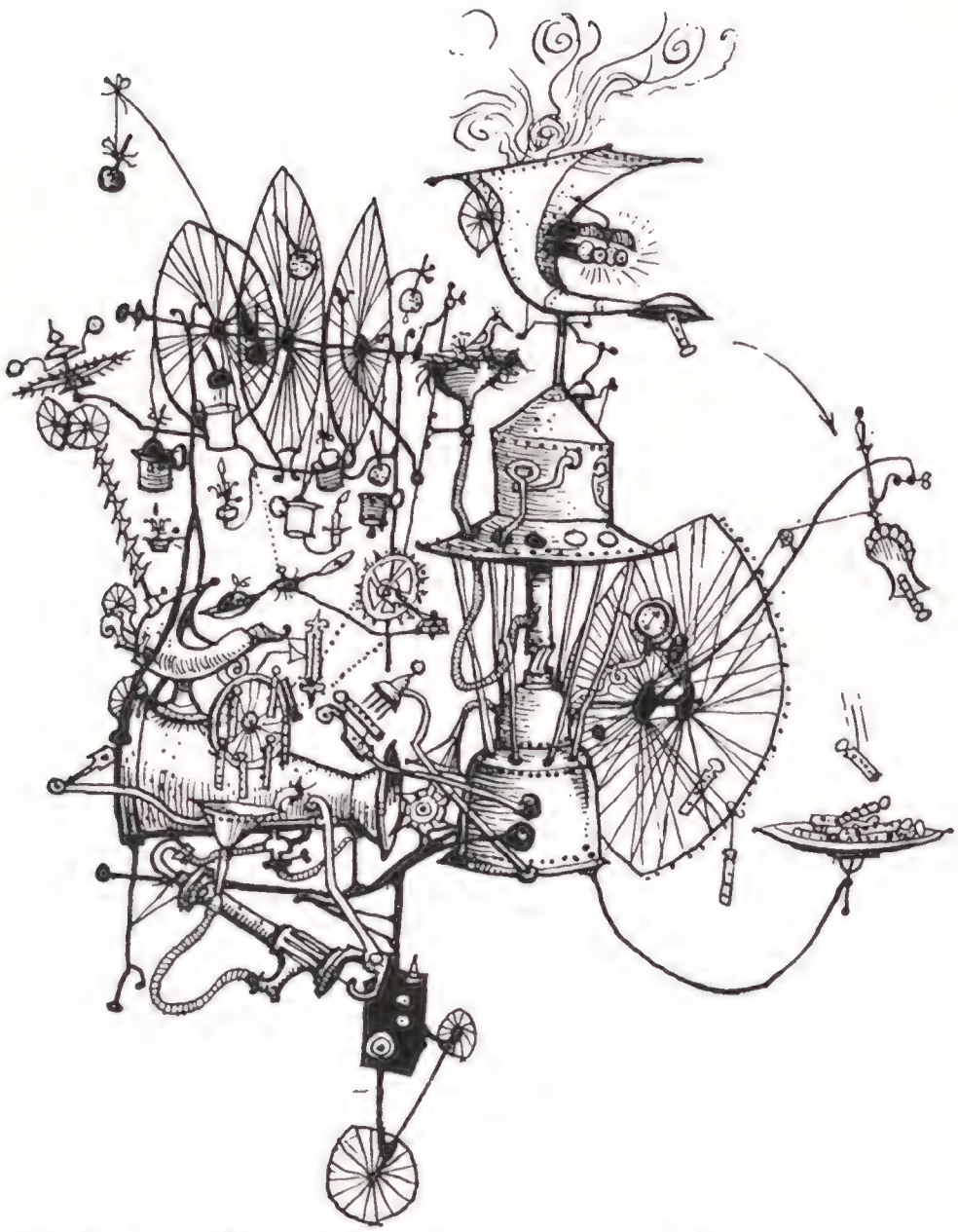
Emett takes the controls of his Featherstone-Kite Openwork Basket-Weave Mk. 2 Gentleman's Flying Machine, which is outfitted with parasols, binoculars, steer-horn handlebars and skillet.

sign work. With no engineering training whatsoever, he spent six months designing a device which a team of Rolls-Royce experts checked over for an hour and a half and then adopted for production. "They told me I was also single-handedly responsible for putting an extra foot of length in the fuselage of the Stirling bomber—but only because I didn't have the faintest idea of what I was doing."

What Emett calls his "first big break" came in 1954, when *Life* magazine sent him on a six-month tour of America to sketch his impressions of the country. "It



This preliminary drawing for the Hush-a-Bye Hot Air Rocking Chair (see cover) includes such outlandish creature comforts as a teddy bear and a pair of ever-ready cantilevered slippers.



began as an assignment for a few black-and-white pages and ended up being 12 pages in color [entitled 'An Englishman's Answer to Yorktown']. They paid me what was then a fortune—$12,320 dollars." This happened to be precisely the price of Wild Goose Cottage, and enabled Rowland and his wife Mary, who until then had spent their marriage in a succession of 14 different furnished houses, to settle down at last.

While this assignment gave the Emetts a home, a possibly more significant turn in his career came earlier, in 1951, when the organizers of the Festival of Britain suggested translating his Far Tottering and Oyster Creek Railway into a reality. The Far Tottering's weird and whimsical rolling stock had puffed successfully enough through the pages of *Punch*, but the cartoonist found it hard to believe that his unlikely train could carry real passengers, even for a short run around an exhibition.

When the Festival's chief designer persisted, however, Emett roughed out a batch of mechanical diagrams for the tall-chimneyed, fancifully domed and canopied train, and an engineering firm was enlisted to construct it. It worked. The Far Tottering and Oyster Creek Railway became one of the Festival's most popular attractions.

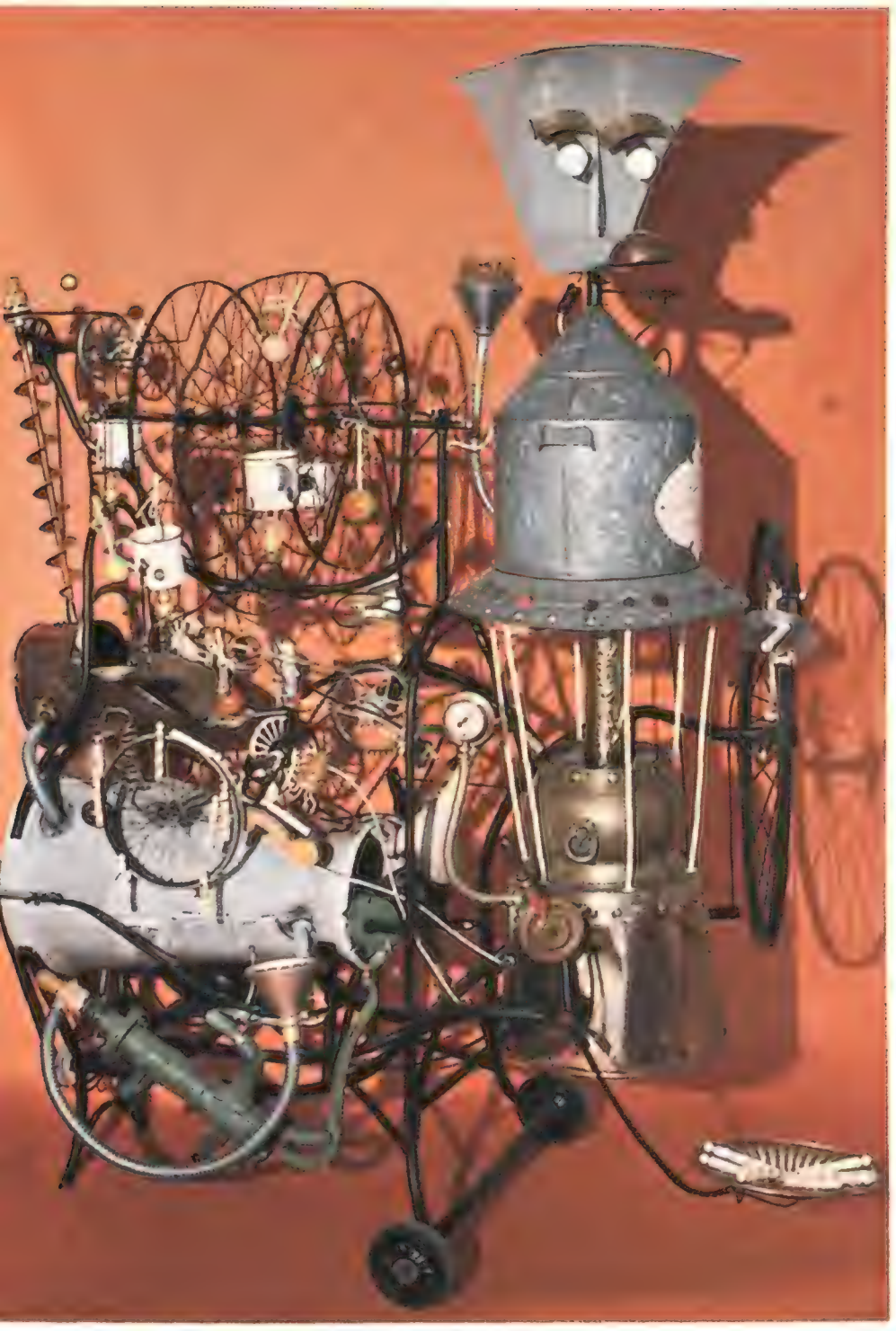
The success of this first Thing inspired him to try another in 1954. "The subject was automation in the home," he recalls. "What did it do? Everything. It was a cross section of a kitchen, sitting room and garden. It had a rose bush, for instance, which bent down and clipped the lawn with a pair of shears, and flowers which obligingly dived into a suction tube and reappeared on the mantel inside, so that during inclement weather you didn't have to go outdoors to enjoy the garden." His automated home was built for one exhibition, but toured Britain for 14 years before it was finally dismantled.

The Humbug-Major Sweet Machine (above and opposite) is one of eight animated machines designed for the 1968 film *Chitty Chitty Bang Bang*. Ostensibly a kitchen appliance, it specializes in such treats as whistling candy sticks and treacle-dipped toffee apples.

As in the machine-oriented world he parodied, each of Emett's creations led to demands for others, and he found less and less time for cartooning. He had just finished Honeywell's noncomputing computer when United Artists asked him to concoct no less than eight of his thingamajigs for *Chitty Chitty Bang Bang*, the film musical based on Ian Fleming's children's story.

"Just as we completed the eight machines and were about to leave on a holiday, the producer rang to say he wanted some copies made to send on promotion tours. We canceled the holiday, thinking, 'I guess he wants about four things—how ghastly.' No. He wanted 50. We managed to make 37."

Emett could not, of course, handle such mammoth commissions alone. Nowadays he employs up to 15 part-time helpers, some cutting and welding alongside him in his 200-year-old forge, others turning out bits



and pieces to his specifications in foundries and workshops scattered across the English countryside. And he has become probably the world's greatest living catalog of out-of-the-way suppliers of the old and/or odd gadgets which find new use in his creations.

He does not, however, keep a supply of this exotic junk on hand. "Some people think we have a big pile of goodies and just dive in, emerging two weeks later with a machine. If we had a collection of things there would be a great danger of building them in simply because they were there. I much prefer to finish the design first and then find what I need."

Hearing Emett describe how he works is an experience not dissimilar to that of contemplating one of his pieces—somewhat brain-scrambling. The process begins, he says, when "I get a crystal-clear mental picture, exactly four-and-a-half inches by two-and-a-half, in color. I draw that on the proverbial envelope, although unlike Edison, etcetera, I use the front of the envelope instead of the back, so I can work the stamps into the design.

"Then I discard the idea altogether and design something else. This never works, but I always do it. Next, I scrap that one, which is inferior, and go back to the first picture, which invariably was the best all along. I sketch it in more detail and make a flat cardboard model."

Then Emett the self-taught engineer takes over from Emett the artist. For although he has help with the construction of his Things, he designs them himself in their entirety, down to the most intricate mechanical details. Once done, the design is followed scrupulously. Complexity requires it. "If we start mucking about with some mechanical movement at this end, we may throw something else out of phase at that end."

Have your cake and eat it part-time

Emett's financial success is due in large part to his wife Mary, who epitomizes that special brand of consort-cum-agent so often found joined, both in wedlock and business, to artists these days. Across a walled garden behind Emett's house is a separate two-story cottage. On the ground floor is Rowland's studio, where he works out his ideas. On the floor above, stacked high with brochures describing his creations and photostats of press clippings, is Mary's office.

From here she wheels and deals with the high echelons of the business world, driving the hard bargains that she feels assure her husband of artistic freedom. "If you attach yourself to the top companies, companies that are wealthy," Mary says candidly, "you can be almost certain you'll be free of worries and that you'll get a good price. I always aim for that."

Normally, none of Emett's work is sold outright but instead is leased to a sponsor for a given length of time. Borg-Warner, for instance, paid $50,000 for his Vintage Car of the Future—but only for five years. If the corporation wishes to continue exhibiting it after that period, it must sign another contract and fork over more money.

"It's called having your cake and eating it part-time," Emett says happily. "It was all Mary's idea. We put it in small print, not even on the back of the contract but around the edge. Seriously, they all understand the reasoning—so we keep a hand in the project to make sure it always looks and performs as it was originally meant to."

So Emett's corporate sponsors are not taken for a ride—neither in the Vintage Car of the Future, which does not drive, nor financially. Fifty thousand dollars is not, after all, such a staggering sum for a full year's

Emett and his Little Dragon Carpet Cleaner peer over Dutch door of his 200-year-old forge-studio.

work—which is the time most of Emett's projects require—from an established, popular artist.

There are, of course, serious hazards for an artist who walks among the disciples of mammon, although so far Emett has escaped them—sometimes narrowly. "When we were working on the Borg-Warner car," he says, "some advertising people in the company thought, 'What a waste that we've got umpteen corporate divisions that aren't being represented in the project.' So someone came down here and wanted to add little bits to the drawing: The something chain drive, the something-or-other air conditioner, the this, the that, and the other, until it looked as if it would be just a catalog of brand names. I was not happy.

"But then we had a letter from the company's highest of the high in America, saying they didn't want to feature *anything* that Borg-Warner made. They only wanted it to be known as the Emett-Borg-Warner car, presented by courtesy of Borg-Warner. Nothing else. No advertising of any kind."

Companies putting up big piles of greenbacks for Emett's Things do like to have their pound of flesh in publicity—which is not a farfetched metaphor when you are hopping across America on short flights, sweating through half a dozen interviews a day. Mary insists that their sponsors never actually demand the promotion tours, but then she seems to thrive on them.

Rowland, on the other hand, seems genuinely to hate this part of his work. "On a promotion tour of America, I die a thousand deaths, one for every time I face a TV or radio interviewer clutching a researcher's brief on which a life's work has been boiled down to a piece of paper this size—and which the interviewer often has not read anyway."

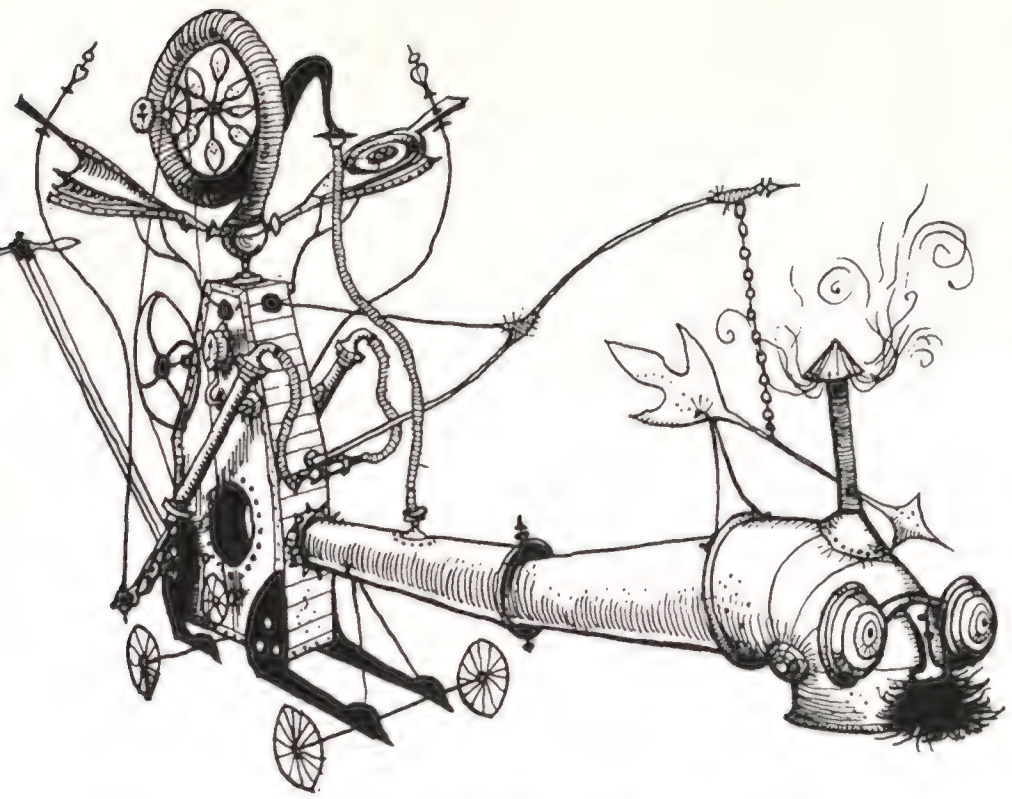
Within minutes of his describing the agony of looking the media monster in the face, his voice reduced to a hoarse whisper from a throat infection and a recent meet-the-press tour, the telephone rings. Mary announces it is a radio station calling from Illinois. He smiles resignedly and takes the call.

"I suppose it's about 4 P.M. there," the telephone interviewer says cheerily, "teatime."

"Yes," Rowland replies in a painful croak, obligingly scouring his never-depleted reserve of wit for the kind of comment he knows the interviewer wants. "If you listen, you'll hear the kettle singing, and I can just see the crumpets crawling in under the door. . . ." He sustains his jovial chatter for more than 15 minutes, torturing his ailing larynx mercilessly. Rowland Emett is a kind man.

And he is an energetic one. Up at five in the morning, he is at work by six. Sometimes, when a problem with one of his Things keeps him awake, he gets up and goes to the forge in the middle of the night "to hold its hand." His vacations are infrequent and usually taken under compulsion from his wife. "He always says we can't go away, that he has too much to do," says Mary. "So I just buy the air tickets and pack. Otherwise he would never rest."

Emett would dearly love to have more time, but not for holidays. "I would like to be able to sit down and do some mad thing which didn't have any commercial strings at all. Strings is the wrong word; the companies leave me free, but at the same time every idea has to be channeled into what is virtually a commercial opening. I want to do something that has never been done before, to astound people, so that they would want to show it without commercial considerations at all."



The Little Dragon snuffles from side to side
in search of dust. Its eyes have magnifying glasses.

Emett is pleased by his success, but so far it has failed to palliate his nagging self-doubt, an apparently deep-seated uneasiness that what he does is not "serious."

"I mean serious in the sense of something that doesn't depend on humor. I was going to be a painter, a serious painter. I was exhibited once or twice in my early twenties. This business about clowns who want to play Hamlet—it still obtains. It's that way with me. But I can't paint anymore. I'm too frightened of getting caricature into anything I paint."

A few weeks after that conversation, Rowland Emett stood in the middle of a vast, newly constructed, enclosed shopping center in Nottingham, England, shifting nervously from foot to foot, making small talk with the men who built the place, and glancing apprehensively at a crowd of several thousand people straining against the temporary barricades around him and leaning over the parapet of the gallery above.

It was, as the bright forest of long-necked television floodlights testified, a media event. A BBC camera swept the mass of onlookers for reaction footage. Sound men tested their microphones and tapes. A score of pen-and-notebook reporters milled about within the fenced-off enclosure. Up on the balcony, Movietone News confounded all those who thought it no longer existed by setting up a camera.

At the center of this assembly the newest Emett Thing (see pp. 42-43), which he had named the Rhythmical Time-fountain, was making its debut. Like a many-footed ballerina it rose on a multiplicity of graceful metal legs from a pool, spouting sparkling jets of water, and lifted its elegant, four-faced clock almost to the ceiling some 30 feet above.

Even without the signature engraved in gold on the marble base, the Emett-ness of the Time-fountain would have been easily discernible. The distinctive elements were there: the delicate intertwining of lines, the carefree spinning of its long arms and vine-leafed waterwheel, the exquisite detail in each tumbling, twirling butterfly with wings of metal lace, the fairy-tale-illustration colors. Here, perhaps, was the apotheosis of Emett's enchanting whimsy, the joyful spirit of the old Far Tottering refined to a glorious sublimity.

"The first time I ever saw it put together was a few days ago," Emett said. "We had to build it in pieces. When they came down to Ditchling to see what they were buying, it was spread all over the forge and the garden in 25 different sections. I had to keep explaining, 'This goes on that, and that piece really goes over there with that one, not where you see it.'

"It took two days here to put it all together and connect up the water and electrics. Then we switched it on and away it went. No problems. It looked and performed exactly as I had always imagined it would. It should be a year before it needs even a drop of oil. We built it to last, and expect to see it still functioning 50 years from now. As it's a permanent installation, we sold it outright, of course, not the usual arrangement."

At that moment the clock began chiming and the crowd suddenly was quiet. Even tiny children who had been noisily splashing their hands in the pool stilled themselves, looking up in expectant silence. The chimes rang at a slow pace, measured, it seemed, for the quality of suspense.

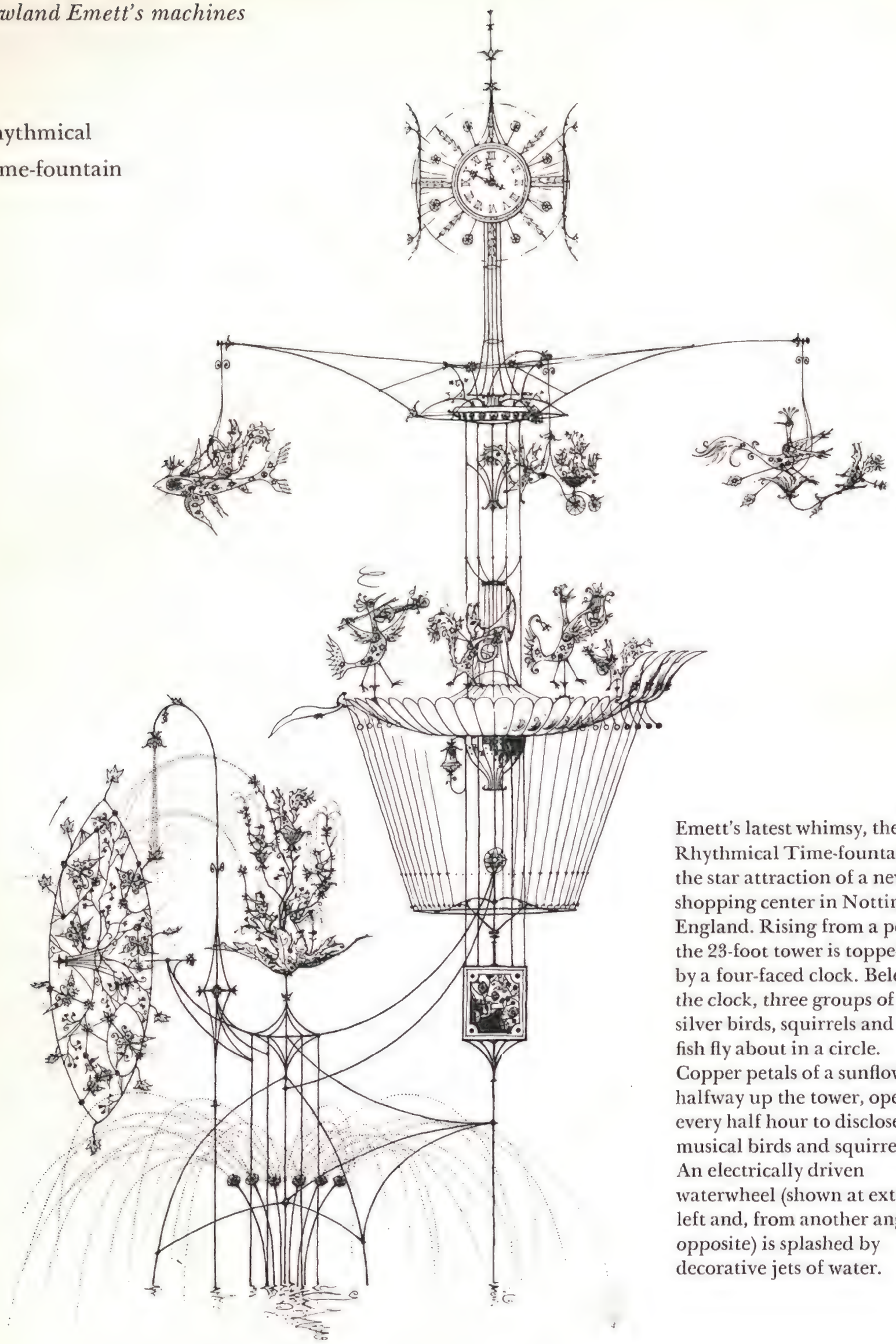
The copper petals close on cue

On the final stroke of the hour, a giant blossom halfway up the tower folded back its big copper petals to reveal an orchestra of gleaming, bejeweled birds and squirrels, each holding a horn, lyre, violin, mandolin or bells. To the electronic accompaniment of a baroque harpsichord melody, these metal musicians whirled into a mad and merry dance, each gyrating wildly on his own axis and the whole ensemble gamboling round and round the central pier of the Time-fountain.

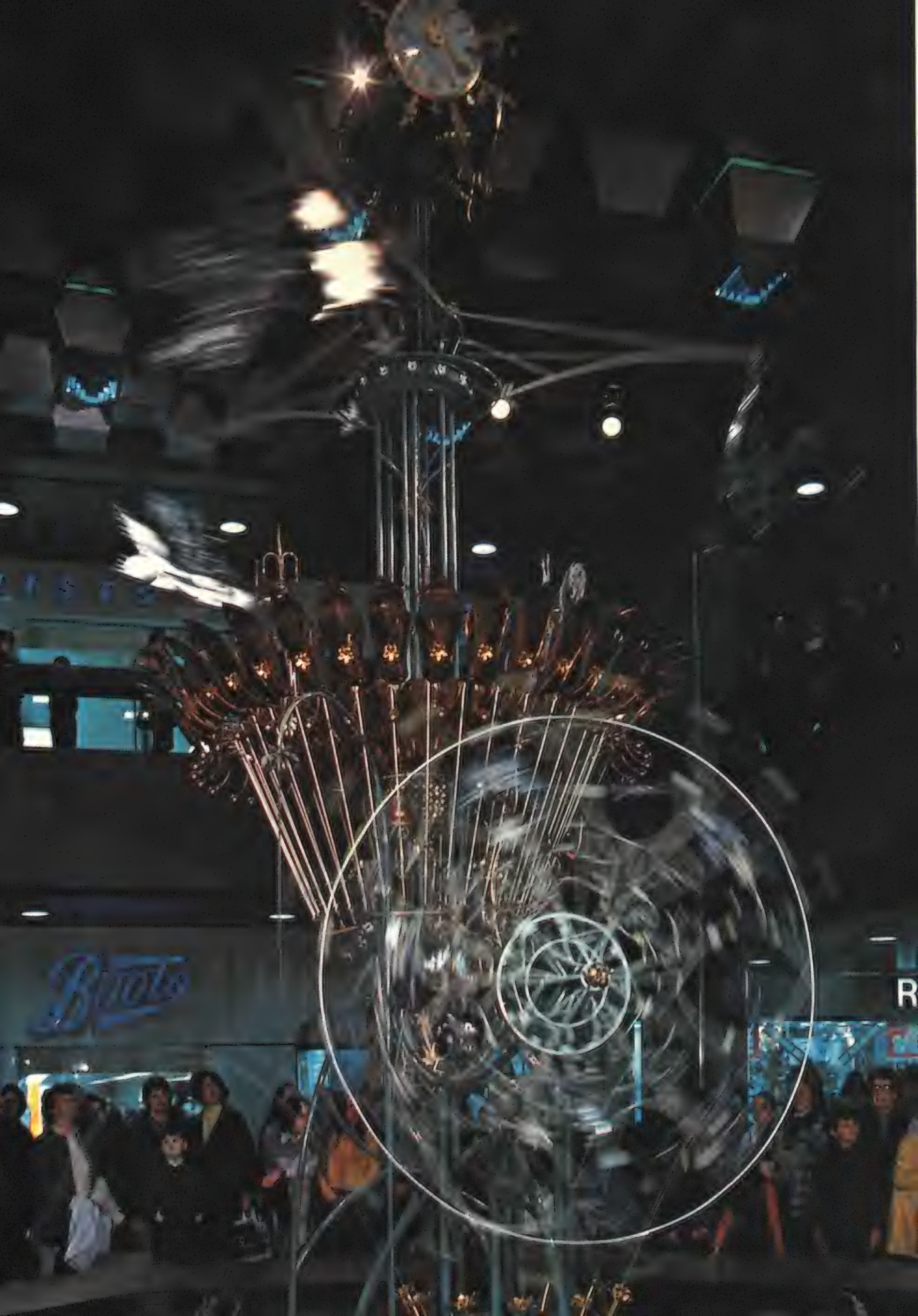
The music stopped. As deliberately as they had opened, the burnished copper petals closed again to await their next cue. For a few seconds, the only sounds were the splash of falling water.

Then bedlam. Children jumped and squealed and laughed ecstatically, their high-pitched voices cutting through the long explosion of applause which reverberated through the hall. And almost nobody walked away. Most would stand waiting for another half hour to see the Time-fountain perform once more.

Rhythmical
Time-fountain



Emett's latest whimsy, the Rhythmical Time-fountain, is the star attraction of a new shopping center in Nottingham, England. Rising from a pool, the 23-foot tower is topped by a four-faced clock. Below the clock, three groups of silver birds, squirrels and fish fly about in a circle. Copper petals of a sunflower, halfway up the tower, open every half hour to disclose musical birds and squirrels. An electrically driven waterwheel (shown at extreme left and, from another angle, opposite) is splashed by decorative jets of water.


Budweiser

This is a soft drink bottle before it's born and after it dies.

About 73% of glass is sand—the most common substance in the earth's crust.

It's this natural composition that appeals to the nation's homemakers. They like what glass shows them about the products they buy. They like the purity of glass and its re-sealability. They like the fact that glass protects the flavor of food and beverages.

Equally important, it's this natural composition that makes a glass container an ideal environmental package. It can be returned to the earth in virtually its original form.

Of course, not all glass goes back to the earth. But because glass is recyclable, more and more is going back to the industry for making new glass bottles and jars.

The glass industry is also continuing to develop new uses for used glass such as road paving material, construction panels, bricks, insulation, terrazzo and reflective paints.

When you add it all up, it's easy to see why consumer preference for glass containers continues to grow. In terms of its attributes, its utility and recyclability, glass is a natural. For a copy of "The glass container story," write: Glass Container Manufacturers Institute, Dept. A, 1800 K St., N.W., Washington, D.C. 20006.

Glass. It's a natural.

By Daniel Jack Chasan

An answer to city traffic may be a horizontal elevator

The solution for computer-age commuters or just trolleys repackaged? Whichever it is, personal rapid transit needs more testing

The scenario is simple and attractive: You walk into a downtown station and press a button, just as you would for an elevator; in no more time than it would take an elevator to arrive at your floor in a large building, a small, driverless vehicle glides silently up along its own exclusive guideway; you enter and, having chosen your destination when you pressed the button, are carried nonstop to another part of the city.

This not entirely hypothetical style of transportation is generally called "personal rapid transit"—even though you may well be sharing that small vehicle with one or two dozen other passengers. Abbreviated to PRT, it is currently the principal new mode of urban transit being developed for the immediate future by the federal Department of Transportation (DOT) and American private industry. The concept of PRT tends to blur at the edges, sometimes embracing everything from small subways to individual capsules to moving sidewalks. But most of the current attention is focused on small, fully automated, electric-powered vehicles, each carrying roughly one to two dozen passengers and running on an exclusive right-of-way, probably some form of aerial guideway.

Exactly how new this version of PRT is can get you an argument. Critics—even some who are generally sympathetic—claim that the whole concept is nothing but the old European street tramway in a new package, and that an illusion of newness has been created deliberately by government officials who want to take credit for innovation and by industrialists who want a great new product to sell. New or not, this is the kind of vehicle being tested in the Department of Transportation's main demonstration project, at Morgantown, West Virginia (opposite). A university town of 32,000 permanent inhabitants stuck away in the hills of northern West Virginia may not seem a very logical place to test urban transportation. But Morgantown had several things going for it, not the least of which were a promising preliminary plan—developed by an Egyptian-born West Virginia University engineering professor named Samy Elias—and a classic case of traffic congestion.

West Virginia University was built in downtown Morgantown in the 19th century; in this century, when the university decided to expand, there was no room nearby, so new engineering, arts and medical centers were built on the outskirts of town. The university's 23,000 students and faculty members then had to shuttle between the downtown and out-of-town campuses by car or bus along one of two narrow streets, with the result that, at peak hours, a route that in the 19th century could be traveled by horse at 11 miles per hour could now be traveled by car at no more than seven. Because the route was hemmed in by hills, a river and railroad tracks, it was not feasible to build new roads or widen the old ones.

Summoned by pushing a button, a 21-passenger car whisks, driverless, along concrete guideway over the rush-hour traffic in Morgantown, West Virginia.

Automatic and not wholly personal

A PRT guideway seemed a logical solution. DOT's Urban Mass Transportation Administration committed money to the project, and the first of five PRT vehicles made its first public test runs along the Morgantown guideway in October 1972. (Long-range plans for the Morgantown system envision a fleet of 70 cars, but for now there are only five.)

Each of the Morgantown PRT vehicles is a small, boxy car with big, tinted windows, carrying 13 standees and eight seated in fiber glass seats, for a total of 21 people. This configuration provides room for the physically handicapped in wheelchairs. The car stands on four rubber-tired wheels and has four-wheel steering, which enables it to negotiate steeper grades and sharper turns than would be routinely possible on rails. Impulses from conductors buried under the concrete guideway start, stop and steer the car. These wires are linked to both individual station control systems and a central computer. The whole system is fully automatic.

Automatic control is the most important single feature of the Morgantown PRT system and the one most likely to make PRT attractive to cities beyond the borders of West Virginia. Ideally, it will give PRT the convenience of the vertical elevator, dispatching cars quickly, on demand, at any time of the day or night, and taking the passenger directly to his destination. Also, it will eliminate the cost of hiring drivers—no small consideration, since labor is the largest single cost of money-losing urban transit systems all over the United States. Lower labor costs will in turn help to make convenient service feasible: No one is going to keep a full-time driver on call to pick up people from odd spots at odd hours, but an automated car costs little more to run if it's on call all the time.

PRTs could take people to and from the stations of larger transit systems, and they could move people around urban downtowns, eliminating or reducing the traffic congestion and polluted air created by private cars. A single PRT line could carry as many passengers as a five-lane highway. Of course, if that single line ran along a poorly designed elevated guideway, even PRT enthusiasts concede that it would be an enormous eyesore. But the more visionary of them also suggest that by allowing urban centers to accommodate human beings on foot, rather than cars, PRT might help preserve the city core as a viable institution.

To do any of these things successfully, PRT will have to compete directly with the private car. Some transit planners have reasoned that PRT has enough in common with the car—neither forces the rider to rub shoulders with many of his fellow citizens, nor adjust to fixed schedules—to stand a fighting chance. A planner involved in San Francisco's Bay Area Rapid Transit (BART) suggests that, in fact, the current concept of PRT "is partly a manifestation of frustration: They're conceding that people love the car, so they're trying to emulate the car as closely as possible." But others think PRT in its present form doesn't have nearly enough in common with the car—its seating arrangement offers little privacy, and its range of destinations offers little choice.

Most people who have given the matter any thought agree that PRT will also have to be coordinated with other forms of transportation and an overall community plan. Some of these same people believe that so far PRT has not been considered in a sufficiently broad context. "Most people who've been on the technological side of it have failed to deal with a lot of the social and institutional issues involved," says Robert Burco, who recently completed a worldwide study of urban transportation for the Paris-based Organization for Economic Cooperation and Development. A longtime advocate of mass transit in a large Western city says that if PRT is used properly—that is, if it takes

Mr. Chasan, who has written about Lake Washington and the bay area's new subway for SMITHSONIAN, *commutes irregularly from home to Seattle by boat.*

To guide automatic steering, small wheels (as above) follow rails mounted on the sides of the concrete path.

Still in the early testing phase, two of Morgantown's five PRT vehicles ply their three-mile guideway.

people within easy walking distance of most of the places where they would normally expect to work or shop—he believes it can preserve the downtown. But he fears that short-term political experience will produce PRT systems that are essentially carnival rides—like the two-stop monorail system that has been functioning smoothly, comfortably and largely uselessly in Seattle ever since the 1962 world's fair (p. 50).

By now, the idea of installing PRT has been discussed throughout the industrialized world, although with varying degrees of seriousness. Some of the most serious talk has been in Japan, where plans are already being drawn up for "net" cities, held together by grids of PRT lines.

In the United States, the city that has done the most planning for PRT is Denver, Colorado. The Department of Transportation announced last October that the next PRT demonstration project after Morgantown would be built there, presumably in time to start operation by 1974. Local Democrats charged that the announcement was made then to boost Republican Senator Gordon Allott's chances of reelection. (Allott lost, as did a proposal to hold the 1976 Olympics in Colorado.) But no one can seriously deny that Denver was a logical site. A six-county transportation plan that was begun in 1969 and will be submitted to Denver-area voters this fall includes an eventual 101 miles of PRT, within the metropolitan areas of Denver and Boulder, and fed by a greatly enlarged system of buses.

But speculation about smaller-scale PRT systems has been scattered across the country. In New York, there has been talk about using PRT to move people around lower Manhattan, in the area of the new World Trade Center, or across Manhattan at 48th Street. In Omaha, where citizens blocked the construction of a freeway through the city, PRT has been considered as a means of moving people back and forth between the freeway's truncated ends.

How much of the apparent interest in PRT goes beyond relatively idle talk? Not much, says Arthur E. Hitsman, Boeing's Morgantown project manager. He is confident, though, that the threshold from talk to action, or at least commitment, will be crossed before long. But Robert Burco says that except in Denver, Sweden's Gothenburg and a few other places, the interest "isn't deep at all—there's just no market for it."

A remnant of the Seattle world's fair, this two-stop monorail is now more entertainment than transport.

One can hardly blame city officials for holding back at least long enough to get the lay of the land. From the perspective of a city official, the crucial question is whether it will attract enough riders, at low enough construction and operating costs, to keep from being a financial disaster. Hitsman says that the primary concern of virtually every city official who comes to talk about Morgantown is, "Will it make money for me?" Theoretically, the Morgantown project will demonstrate PRT's audience appeal, but even enthusiasts have a hard time believing that a small system operating along a single corridor with a more-or-less captive ridership will prove much about the workings of a larger system in a full-fledged city. A larger, federally financed demonstration will have to be tried.

The federal government, however, seems unlikely to do much investing in the near future. The federal budget submitted for fiscal 1974 cut back PRT research, development and demonstration funds by roughly one-half, just as it reduced federal support for many other kinds of research. The cutback means chiefly that the DOT can't sponsor another demonstration project in the coming year—which may be of negligible significance, since the only one planned had been Denver's.

DOT hasn't abandoned the current idea of personal rapid transit, though, and neither have the eight big aerospace and related firms now working on PRT. In fact, for such companies, all of which want to diversify, PRT offers a perfect outlet: It uses their pools of engineering talent to advantage, and offers the prospect of a real production-line product in the near future.

Competition from the lowly bus

The question is, what are the alternatives? First and foremost, there is the bus. It is probably true in most places that, as former federal Urban Mass Transportation Administrator Carlos Villarreal has said, "the first step out of the automobile is the bus." It is also true that DOT is financing the development of buses that are easier to enter, more comfortable to ride in and less smelly to be around. And by drastically reducing fares, Atlanta, Iowa City and Seattle have increased the number of people willing to ride their buses.

In fact, there is no doubt that cities will go on buying buses for years to come. But somehow it is hard to believe that any enterprising city mayor thinks all his transportation problems can be solved by the lowly bus. Buses have no cachet. Also, in a period of environmental consciousness, they are still cursed with internal combustion engines. And, last but not least, city bus systems tend to lose money.

Big rail-transit systems like the San Francisco area's BART are another possibility, but they have limited

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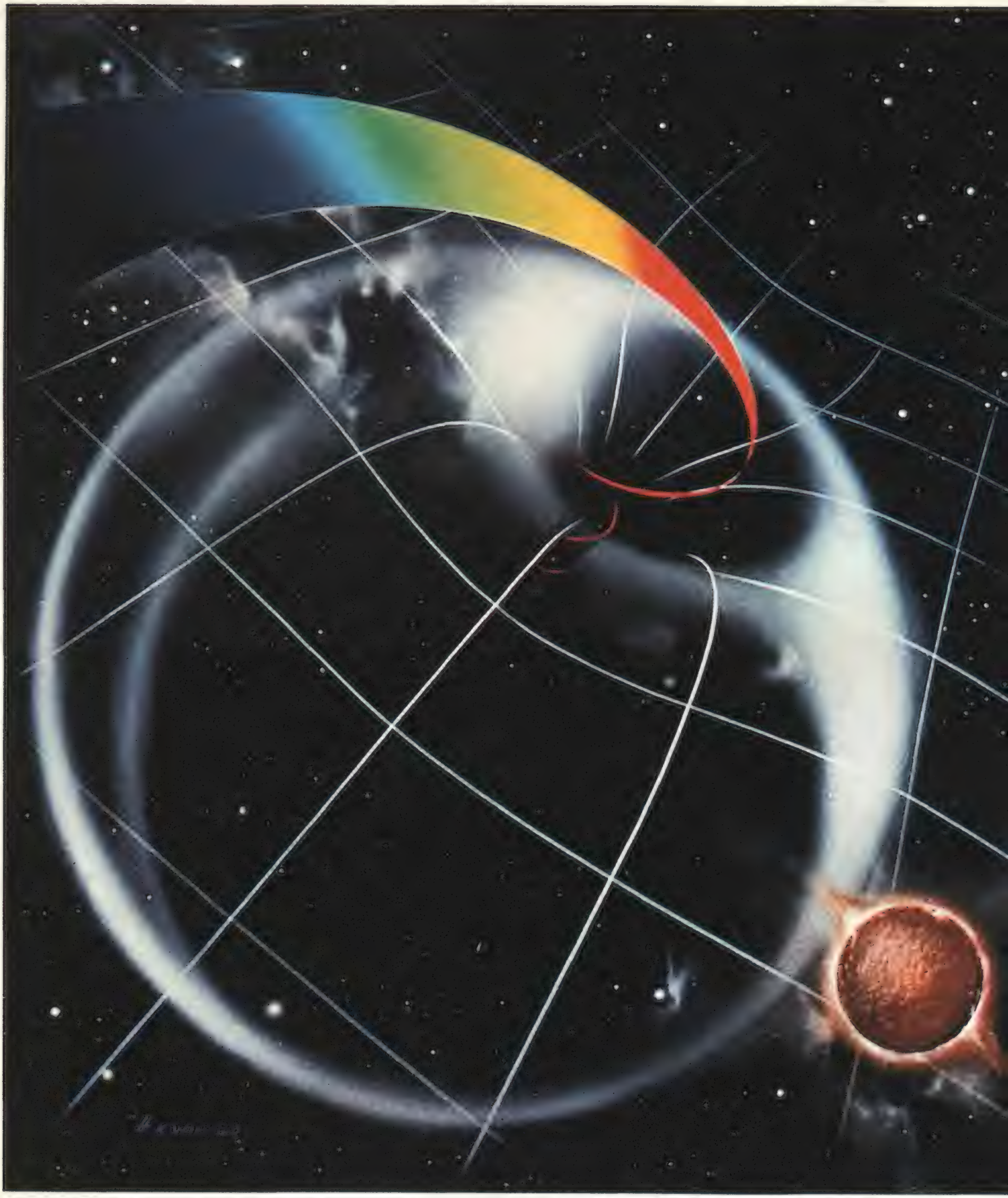
appeal. They are very expensive to build, and there is a widespread belief that unless they are built in cities with unusually high population densities, they simply won't pay. Then there are the really advanced transit technologies, like air-cushion and magnetic-levitation cars. They work—and could, in fact, be adapted to PRT—but probably no city planner would volunteer to work the bugs out of them.

All of that leaves personal rapid transit in a fairly good competitive position. Thanks to the Urban Mass Transportation Act of 1970, DOT can provide financial aid for any community that decides to build a PRT system, which doesn't detract at all from PRT's appeal. The private companies now working on PRT will certainly give it the benefit of hard, persistent salesmanship. It will grow even more appealing if a future Congress manages to pry money for urban mass transit from the Federal-aid Highways Trust Fund (as the Senate voted to do this last spring). The Nixon administration's proposal for opening the highway fund, which would provide capital for new systems but no operating funds for existing ones, would stand capital-intensive PRT in particularly good stead. And, as one knowledgeable observer puts it, what big city mayor can be totally immune to the lure of "cutting the ribbon on the first PRT?"

For all sorts of reasons, then, PRT may be an idea whose time is about to come. It is still much too early to prophesy with assurance that as goes Morgantown, so will go the nation—but a bit too late to prudently write it off.

In Artist Nicholas Solovioff's conception, a future urban center is more livable as personal rapid transit links up with other people-moving devices including escalators, buses and even a few cars.



Artist Helmut Wimmer's conception of the unseeable: So great is the force of gravity when a star collapses to form a black hole, that no wavelengths of light can escape it. A red giant star is at lower right.

By Ben Bova

Obituary of stars: tale of red giants, white dwarfs and black holes

After long, violent careers in various roles, some celestial bodies, astronomers believe, may disappear out of space and time in an instant

In the predawn darkness of September 2 last year, Robin Conway, a British radio astronomer, received a frenzied phone call from America. An x-ray-emitting star named Cygnus X-3 was exploding.

Radio astronomers in Canada and the United States had observed titanic flares of energy coming from Cygnus X-3, and they wanted Conway to get the huge Jodrell Bank radio telescope on it in time to catch this unexpected and dramatic event. Within hours, observatories all over the world were aiming their instruments at Cygnus X-3.

For about ten years astronomers had been observing sites in the sky that are powerful emitters of x rays. Theoretical considerations led them to the conclusion that these x-ray *sources,* as astronomers refer to them, are dying stars—or at least they were dying many thousands of years ago when they emitted the x rays we now receive on Earth.

In the month following Cygnus X-3's first flare-up, four separate bursts of energy were detected and many astronomers believe they witnessed the death throes of a star. A few go even further, claiming that Cygnus X-3 is actually a star that has collapsed and disappeared from our universe: a black hole. In other words, they have "seen" something absolutely invisible. A black hole is the ultimate in stellar deaths. The dying star literally performs the old joke of "digging a hole, jumping in, and pulling the hole in after it." No light, no heat, no particle of matter can escape from a black hole; it is a cavity in space (see opposite page).

Of considerable interest to us on Earth is the question: Will the sun one day disappear in a black hole, dragging its planets, including Earth, down with it? Not likely, according to current theories. But, like all the stars, the sun will die. How? When? To answer that, consider another question: What keeps the sun basically at its present size and shape?

The sun is a star, as nearly perfect a sphere as you'll find anywhere in nature. Its diameter is 865,400 miles, more than 100 times that of the Earth—but the sun is only medium-sized as stars go. If you could see a time-lapse movie of the sun's formative years, you would see a huge distended cloud of gas and dust falling inward on itself—a process called gravitational collapse. This event took place nearly five billion years ago, but it happened in an astronomical eye-blink: a scant 50 million years.

Then the gravitational collapse stopped, leaving the sun as a sphere of glowing gas. The gravitational force is still there, still trying to squeeze the sun's two billion billion billion tons of matter (that's 2×10^{27} tons) into a still smaller sphere.

But balancing the inward-pulling force of gravity are the outward-pushing forces of gas and radiation pressure. The gas pressure at the sun's core is at least 1.3 billion times the pressure of air at sea level here on Earth. At the core of the sun, temperatures reach some 15 million degrees Kelvin (which is about 27 million degrees Fahrenheit), hot enough to allow thermonuclear reactions in which hydrogen is converted into helium and releases energy, adding to the outward pressure of the gas.

For nearly five billion years the outward and inward

Author of The New Astronomies *and editor of* Analog *magazine, Ben Bova wrote about the potential of hydrogen fusion in* SMITHSONIAN, *December 1972.*

Rotating like a searchlight, the pulsar in the Crab Nebula spins, beaming light and x rays toward

forces have been neatly balanced, keeping the sun at about the same size and shape, although its mass is changing imperceptibly. But in another five to ten billion years, the sun's supply of hydrogen fuel will begin to run low. Most of its core will be denser and hotter than it is now, some 100 million degrees Kelvin at its center. The helium itself will then begin to undergo fusion reactions, forming carbon, oxygen and neon.

Gravity will yield somewhat to increased gas and radiation pressures, and the sun's outer layers will expand. The shining surface of the sun, called the photosphere, will become distended and cooler, and will turn redder in color. The sun will become what astronomers call a *red giant* (see pp. 62-63). The sun's outer envelope will become hugely bloated and reach out to engulf the inner planets, including Earth.

As the fusion processes in the sun's core produce constantly heavier elements, the core temperature will keep rising. The higher the core temperature, the more easily new fusion reactions start with the heavier elements, leading to the creation of still heavier elements and still higher temperatures.

A character in a Hemingway novel was once asked how he went bankrupt. "Two ways," he said. "Gradually and then suddenly." The same thing happens to stars, and gravity is the waiting banker who eventually forecloses all the loans.

Were we to be present, we would see that in the aging star each new cycle of element-building goes faster than the previous one. Each cycle brings the sun closer to disaster. Through it all, gravity is constantly being outfought by rising gas and radiation pressures.

Ultimately, fusion reactions at the sun's core produce iron. Further fusion reactions with iron do not release energy, they require it. The game is over. The temperature of the star's core slows its upward spiral, energy production at the core shuts down, the outward pressures of gas and radiation die away. And gravity, which has been waiting all this time, becomes the victor. The sun will now collapse.

Into a black hole? Apparently not; the sun is too small a star for that. Instead it will become what is called a *white dwarf*.

Astronomers discovered the first white dwarf in 1915 —the tiny companion of the bright star Sirius. (Since Sirius is known as the Dog Star, its white dwarf companion was inevitably dubbed the Pup.) White dwarf stars were then thought to be the end point in stellar evolution. They are just as massive as an ordinary star, but they are squeezed down to a size more like that of the Earth—some 100 times smaller than even a medium-sized star.

The question then became: How does a star go from its distended red giant phase down to a collapsed white dwarf? The problem sounds more like something out of a fairy tale than a problem in astrophysics, but it was—and is—a critical problem for the understanding of the death of stars.

Stars have been known to explode. Sometimes they explode rather mildly, in cosmic burps called *novas*. A nova outburst does not damage the star much—some novas may repeat their flare-up every few thousand years. Of course, anyone living on a nearby planet would be incinerated by even a mild nova outburst.

the Earth about 30 times a second, blinking off, on (center) and off again. The pulsar is a neutron star core, the remains of a more massive star that suffered a huge explosion, creating the Crab Nebula.

There are also more catastrophic stellar explosions, called *supernovas,* that release as much energy in 24 hours as the sun emits in more than a billion years.

After the first white dwarf was discovered in 1915, many astronomers believed that red giants eventually exploded and the white dwarfs were the remainders left after the cataclysms. Now we know this is not *always* the case. Stars that are of the sun's mass may end up as white dwarfs without any traumatic explosions at all.

Computer analyses show that as gravity begins to compress the sun, after its red giant phase has ended, the density and temperature inside rise. As its inner temperature soars, any unused fusible materials—from hydrogen to iron—will eventually reach their ignition temperature, and explode like cosmic firecrackers. Eventually the increasing density and temperature produce a braking action that halts the collapse. The sun's collapse may take place over a span of a few million years, gradually sinking from its grossly distended red giant diameter down to a size more like our own Earth's—about 8,000 miles across.

When all the material in the sun has been squeezed down to this small a size, it is so dense that if you had a teaspoonful of it, it would sink to the center of the Earth instantly, plowing through rock and metal as if they were quicksilver.

Again, why does the gravitational collapse stop? Why won't the sun get even smaller and denser? The answer lies in what happens inside the sun.

Like all stars, the sun is composed of plasma, which consists of ions (atomic nuclei that have been stripped of their orbital electrons) and free electrons. As the density of the plasma increases, these ions and electrons collide more frequently. They are squeezed more and more, until at a density of about a thousand tons per cubic inch the electrons resist further compression. This produces the counterforce that finally balances out against gravity and stops the sun from collapsing any further.

So now we have the sun as a white dwarf, just about the size of Earth, though still with about 330,000 times more mass. Henceforth, it simply cools off, as the heat generated from its collapse dissipates slowly into space. This process may take billions of years, but eventually the sun will be nothing more than a cold, dark cinder, circled by frozen planets.

So much for the sun; a fairly ordinary star. But there are many stars with greater mass than the sun and if you thirst for yet more drama in the skies, consider the death agonies of these more massive stars (see illustration, pp. 62-63). Stars that are at least half again as massive as the sun don't stop collapsing at the white dwarf stage—and they reach that stage differently.

Obituary of stars

If there is enough unburned fusible material in the star's outer shell after its career as a red giant and an unstable period as a pulsating star, the rapidly rising heat of the core may trigger those superficial explosions called novas. These blow off some of the star's outer envelope of plasma and may destroy any planets nearby. But the core of the star survives. It keeps on shrinking, passing quickly through the white dwarf stage. The electrons' resistance to compression cannot counteract the pull of gravity because the gravitational force is much stronger, being proportional to the star's mass. The collapse goes on. The electrons are squeezed into the protons (particles of the atomic nuclei) in the plasma, turning all the protons into neutrons.

We now have a mass at least equal to the sun's, the core remainder of an originally more massive star, that consists entirely of neutrons packed side by side into a sphere no more than 100 miles wide—probably more like ten miles wide. It contains some 10^{57} neutrons, squeezed together at a density of about a billion tons per cubic inch.

We have a *neutron star.*

If the star at this stage is not more than about three solar masses, then the tremendous repulsive forces that the neutrons exert on each other will resist any further gravitational crunch. The brakes are on—neutron brakes this time—and the collapse stops.

But there are still the outer layers of the star, even though much of this material might have blown off in one or more explosions. What's left of this outer shell falls in on the tiny neutron core, since gravity is always at work. The impact creates enough heat to drive the core's surface temperature up to billions of degrees for a fraction of a second. Under these circumstances most of the heat energy is converted into the strangest particles in all of physics: neutrinos.

Not to be confused with neutrons, neutrinos are aloof little particles which, under ordinary circumstances, can zip through a wall of lead *50 light-years thick* without being stopped at all.

But the conditions around a neutron star are far from ordinary. The densities and temperatures of the plasma are so high that even the evasive neutrinos can travel only a few feet before they are deflected or absorbed. Most of their tremendous energy is imparted to the plasma clouds, heating them to tens of billions of degrees. This creates a supernova explosion that blows away everything except the tiny core of the neutron star.

All this—the collapse of the neutron core, the infall of the shell of plasma, the heating that forms the neutrinos, the core supernova explosion—all this happens in a few seconds.

The result? Look at the Crab Nebula, that wildly twisted cloud of plasma a few light-years across, still expanding at several hundred miles per second more than 900 years after the core supernova that created it (SMITHSONIAN, June 1970). The Crab Nebula glows with a full spectrum of electromagnetic energy: radio waves, infrared, visible light, ultraviolet, x rays and even gamma radiation. And in the center of the Crab Nebula, beautifully verifying all the theories and calculations, is a pulsar!

No little green men

For the pulsars, most astronomers now believe, are actually neutron stars that are emitting sharply timed bursts of radio energy.

The first pulsar was discovered in 1967 by Jocelyn Bell and Antony Hewish of Cambridge University. Within a few months a half dozen more were found, including the pulsar in the Crab Nebula, which is designated NP 0532 (see pp. 56-57).

When the pulsars were first discovered, their uncannily precise radio bursts led some astronomers to wonder if these might not be radio signals from intelligent beings. For a few weeks they were informally called LGM signals—for "little green men." By the end of 1967, Thomas Gold of Cornell University and several other theoreticians had proposed natural models that seemed to explain the pulsar phenomenon without resorting to interstellar civilizations.

Gold's theory is the most widely accepted at present. He pictures the pulsar as a neutron star that is spinning rapidly while surrounded by fairly dense plasma clouds, the remnants of the supernova explosion. The observed timing of the pulsars' radio bursts, all grouped around the 1 to 100 times-a-second mark, fit in well with the expected spin rate of a 10- to 100-mile-wide neutron star.

The discovery that the pulse rate of the Crab Neb-

Who, theoretically speaking, needs black holes?

The idea of black holes began as just that—a theoretical necessity in the now dominant concept that the universe is expanding, the result of a single, massive event known as the big bang. Recent observations, such as the discovery of objects called quasars that appear to be moving away at fantastic rates, support this theory and have made trouble for another school of thought which holds that the universe is in a steady state.

Indeed, steady-state theorists are in something of the same position as later Ptolemaic astronomers whose model of the heavens had to become ever more complicated to explain each new observation. Nevertheless, steady-state theory has its adherents and one of them, according to the *New Scientist,* under a headline saying: ". . . are Black Holes really necessary?", suggests that black holes do not exist. In the upper realms of mathematics in which cosmologists regularly deal, J.V. Narlicker argues that whatever your cosmological preference, it is possible to explain the universe without resorting to black holes.

Be that as it may, astronomers are scouring the skies, seeking them. Not only has Remo Ruffini of Princeton University claimed to have found them (see below), but so have five observers at Mt. Stromlo Observatory in Australia.

Optically observing an x-ray star (designated 2U 0900-40) in the southern hemisphere, they believe they found a binary star system consisting of one very massive, visible star being orbited by a much smaller, invisible and therefore dead star—a black hole. As matter from the large star is ripped away by the intense gravity of the orbiting black hole and disappears into it, energy is emitted in the form of x rays.

Even better than finding a black hole would be to watch a pulsar collapse into one, for that would be to see a model of the ultimate collapse of the universe—two situations in which the law of physics are transcended. Such are the thoughts, at least, of John A. Wheeler of Princeton, a chief black hole theorist who spoke at the Smithsonian Institution, National Academy of Sciences symposium on the nature of scientific discovery last April (see SMITHSONIAN, April 1973). And what, in the way of scientific discovery, lies beyond black holes? Said Wheeler: "the greatest mystery of all—why there is something rather than nothing."

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ula's pulsar was lengthening supported Gold's explanation. Early in 1969 the Crab Nebula pulsar was detected visually and photographed. The optical pulsations are in synchronization with the radio pulses, as theory predicted they would be. At least one pulsar shows a rate of pulsation that occasionally speeds up, only to gradually slow down again. This most likely means that this neutron star is jerkily shrinking, still being crushed to a smaller size by gravity.

How far can the crush go? According to theoretical physicists, such as Kip S. Thorne of the California Institute of Technology, under the right circumstances a star can literally go straight out of this universe. Into a black hole.

Let's take another look at a neutron star, using the eyes of imagination to peer through the swirling carnage of plasma clouds that surrounds it.

The neutron star has already suffered a gravitational collapse and supernova explosion. If the core's mass is not more than about three times the sun's mass, its collapse stops at this phase. For several thousand years the neutron star will radiate more rays than any other type of electromagnetic energy.

The neutron star can also cause radio and optical pulses, although these are likely to be coming from the plasma cloud surrounding the star, rather than from the neutron star itself. After a hundred million years or so, the neutron star's temperature cools down and it will become a quiet, dark chunk of extremely dense matter measuring some 10 to 100 miles across.

But if the neutron star is more than about three solar masses, the gravitational infall doesn't stop. The star keeps on shrinking, and the gravitational force gets mightier with each microsecond.

As the interior density goes past the ten-billion-tons-per-cubic-inch mark, the neutrons themselves are squeezed down into smaller subatomic particles called hyperons. At this point, no possible braking force can stop the collapse. The gravitational force becomes all-consuming. For a star of about three solar masses, once its radius gets down under two miles, it winks out. (This is called the *gravitational radius,* the radius at which light can no longer escape from the star.) When the star collapses past that size, it has dug itself a black hole in space-time and disappeared into it.

But the gravitational collapse does not stop simply because the outside world can no longer see the star. According to an early theory, the star keeps on collapsing until it reaches the almost unimaginable state of zero volume and infinite density. Such a point is called a *Schwarzschild singularity,* after the German physicist Karl Schwarzschild (1873-1916).

What would it look like if you could watch the final disappearance of a star as it collapsed into a black hole? You would have to be able to see in x-ray wavelengths, because that is what the collapsing star is

radiating. And you would have to be able to see through the plasma clouds surrounding the scene. Most of all, you would have to look very fast, because the whole affair happens in less than a second. (According to computer calculations, that is; under the influence of such titanic gravitational fields, perhaps time itself becomes warped out of all recognition.)

One moment the dying star is hanging there in the midst of the plasma cloud, then suddenly it shrinks like a pricked balloon, getting smaller and smaller.

The photons of x-ray energy must now work harder to get away from the fast-increasing gravitational field. This shifts them to longer wavelengths. Perhaps they are shifted even far enough to turn into light waves.

At last—still within the space of a second, remember—the collapse will seem to slow down. A few x rays are struggling up from the rim of the black hole. The star finally disappears, but there's a dim halo left, where those last few x rays are taking tortuously spiral paths to work out of the gravitational pit that the star has dug for itself.

If we can envision an interstellar spacecraft, it could approach a black hole quite closely without being sucked in. If the spacecraft were going fast enough, it could orbit around the hole's gravitational radius, just as a satellite can orbit around Earth if it has the proper velocity. But should the spacecraft wander inside the gravitational radius—goodbye! It can never get out again, no matter how mighty its engines.

Gravitational collapse into a black hole can also happen to objects larger than individual stars—an entire galaxy could theoretically collapse. Interstellar space might be strewn with "potholes" ranging from a few miles to a few million miles across, black holes where individual stars or whole galaxies have collapsed in on themselves.

We can now see why there was such worldwide excitement over Cygnus X-3 when it flared up. Here was an x-ray source that must be a neutron star and possibly might be a black hole.

Cygnus X-3 is located in the region of the sky mapped out by the constellation Cygnus, the Swan. In 1966, a group of scientists led by Riccardo Giacconi of All-American Engineering Corporation found that there were several sources of intense x-radiation in Cygnus. X-3 was the third such source discovered in that area of the sky. It is apparently far out on the fringes of the Milky Way galaxy, roughly 30,000 light-years away from us.

Cygnus X-3 was soon found to be emitting radio waves as well as x-rays, although it was a rather weak radio source. But on September 2, 1972, a team led by P. C. Gregory of the University of Toronto, using the 150-foot radio dish antenna of the Algonquin Radio Observatory in Ontario, was surprised when they discovered that Cygnus X-3 was suddenly 1,000 times stronger in radio emission than it had been only two days earlier.

X-ray telescopes aboard the satellites *Uhuru* and *Copernicus* showed no increase in the star's x-ray output. (Since x rays do not penetrate the Earth's atmosphere, x-ray detectors must be placed in high-altitude balloons or rockets, or aboard satellites.) The radio emission was not coming from the star itself but from the plasma cloud surrounding it.

Over the next month, four different outbursts were observed, some of them with "flares" that lasted only about an hour. Generally, though, the active periods were about 24 hours long, indicating that the cloud producing them is one light-day in diameter—that is, about two-and-a-half times the diameter of our solar system as we know it.

A star with a dead partner

Remo Ruffini of Princeton University believes that Cygnus X-3 is a black hole which began its life as a very massive star and now has exploded and collapsed. It is part of a binary, or two-star system, he claims, citing evidence that indicates Cygnus X-3 is rotating around a partner star every 4.8 hours. The x-ray and radio output may be caused by matter from the partner star being sucked into the black hole. Ruffini also believes that at least two other x-ray sources—Cygnus X-1 and Small Magellanic Cloud X-1—are also black holes that were once members of binary star pairs. Other astronomers and physicists disagree strongly. They feel that it is much too early to declare these objects black holes. The evidence is at best hazy and uncertain, and even the black hole theory is questioned (see box, p. 59).

If astronomers have detected black holes, they are

literally studying things that no longer exist in our observable universe. Or do they?

In that strange world inside a black hole, where an entire star is crushed down toward zero volume and infinite density, what physical rules are in effect? In this realm, theoreticians rely on mathematics and—in a sense—on poetry. Even the relativistic physics of Einstein can't explain what happens at such densities. No one knows what happens, physically, down at the bottom of a black hole—except that it may be bottomless. Or even open-ended.

Several theoreticians have pointed out that the mathematics of gravitational collapse and Schwarzschild singularities apply only to perfectly spherical bodies. Stars are not exactly perfect spheres; galaxies are even less so. As they are gravitationally crushed, it is likely that any deformations in their shapes will become exaggerated, not smoothed out. Roger Penrose, a British mathematical physicist, has shown that a nonspherical body would not be completely crushed to zero volume. For reasons known best to the mathematicians, such a body can escape dwindling down to a singularity, but it can't stay in the same physical location where it collapsed. In effect, the black hole turns into a tunnel.

Space warps and time warps

We can visualize this by drawing on an analogy that relativistic cosmologists have often used. The universe consists of four dimensions: three spatial dimensions, and one dimension of time. Picture space-time as being represented by a thin, very flexible sheet of rubber. It is curved, perhaps quite intricately convoluted.

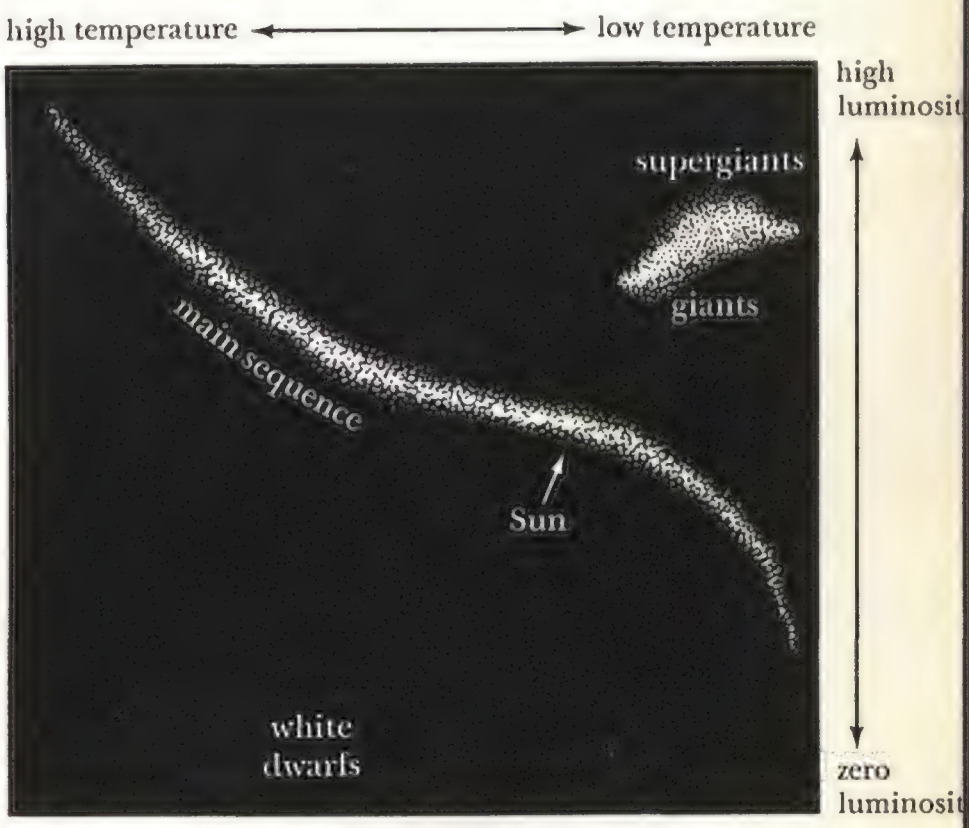
Massive bodies such as stars can be thought of as tiny ball bearings resting on this rubber sheet. The bigger and more massive the star, the deeper the dimple it makes in this otherwise smooth sheet. For a star or galaxy that is collapsing into a black hole, the dimple starts to look more like a tunnel—a long, thin tube stretched in the fabric of space-time by the gravitational collapse of the massive body.

If the body does not dwindle to a singularity, then the tube-tunnel might emerge somewhere else in space-time. The star or galaxy might have dug its way out of one place in the universe and reappeared somewhere, and perhaps *sometime,* else. Several cosmologists have suggested that the enigmatic quasars, which appear to be incredibly distant and more powerful than a hundred ordinary galaxies, might be the explosive reemergence of a collapsed galaxy. In this view, a quasar represents a "white hole" at the end of a tunnel through space-time that began with a black hole.

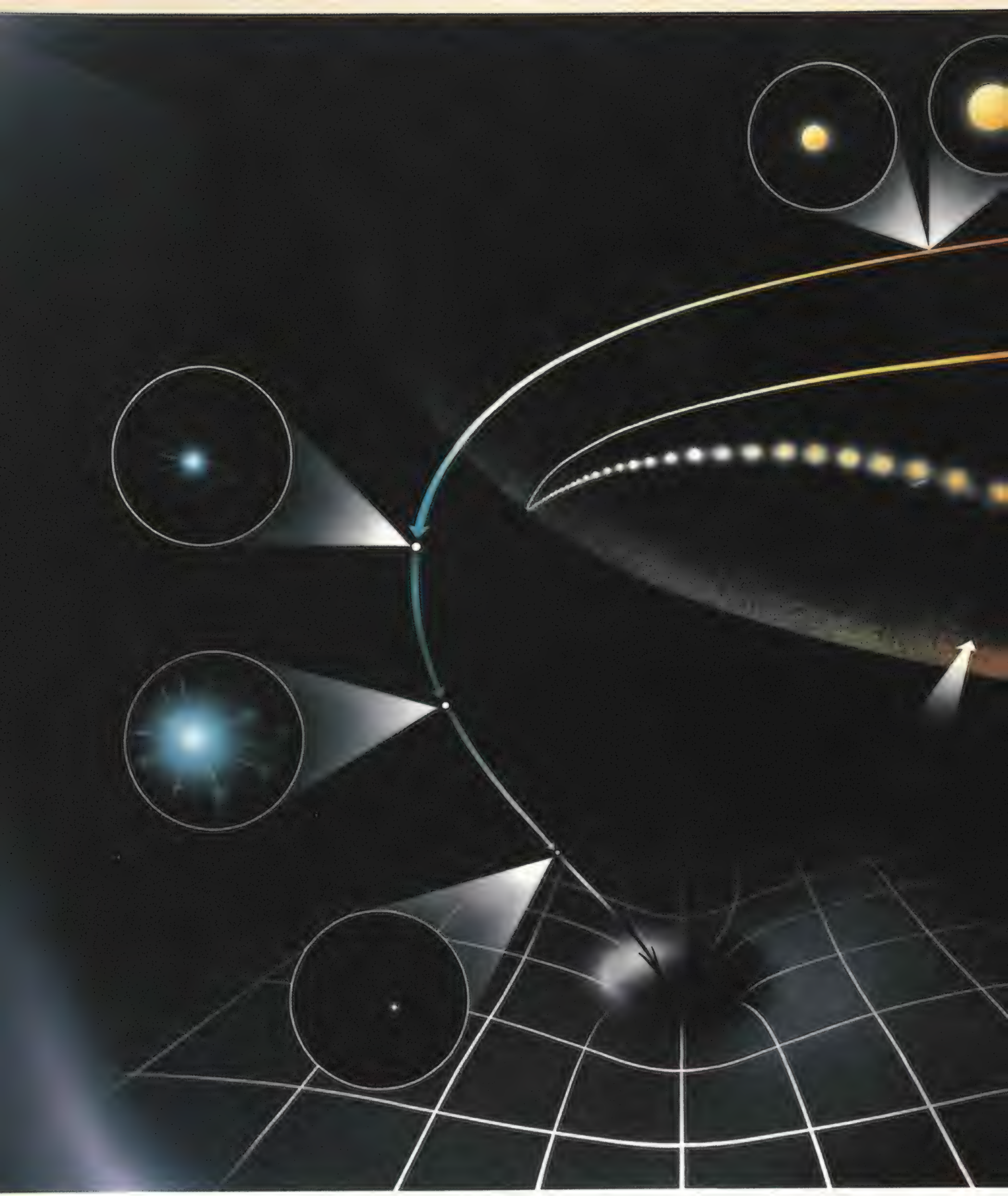
No one has seriously proposed explaining the physics of this phenomenon. Where even relativistic physics breaks down, you can't expect more than a shrug of the shoulders when you ask questions. At the densities and gravitational-field strengths involved, it seems clear to the theoreticians that the entire fabric of space would get badly bent. Dare one use the science-fiction term, "space warp?" Just as space is warped and stressed under the titanic gravitational forces, time itself might be stretched, warped, changed. Certainly we shouldn't expect time to flow at the same rate inside a black hole as it does elsewhere.

What would such tunnels be like? Would they stay intact, forming a sort of underground railway system crisscrossing the fabric of space-time? What happens to time inside such a tunnel?

Could it be that, if we ever do build star-faring spacecraft, far from avoiding black holes, we will seek them out, looking for a "Northwest Passage" between here and the most distant regions in space—or, perhaps, beyond space?



On a graph called a Hertzsprung-Russell diagram, astronomers plot temperatures of stars against their luminosities (see next page). They find that most stars, including the sun, are located along a main sequence. Stars at the upper end are brighter, hotter and more massive than those at lower right end. Some stars, however, are fainter than main sequence stars of the same temperature and are called white dwarfs. Some others are brighter than stars with comparable temperatures, and they are therefore larger as well: These are giants and supergiants. Stars spend most of their lives in their original positions on the main sequence; then, in their old age, they rapidly move through giant and dwarf phases.



Stages in the life of a star are shown on a diagram (as on p. 61) . From a cloud of gas and dust (red arrow, right) a star forms hotter and more luminous than the sun (white arrow, center). Near

the end of its life, the star becomes a red giant, bright and still massive (upper right). It then passes through a stage of instability and pulsates (top, center). At left, the star is shown as small explosions, called novas, and then a large explosion (a supernova), blow off some of its mass, leaving a tiny, faint neutron star core. As it contracts further, it winks out altogether, ending up as a black hole in space.

By Ann Natanson

Sculptor Manzù's own museum, and then there is Inge

Italy's famous artist, who lives on a hilltop called the Field of the Fig Trees, has a building devoted to his work

Since 1965 Italy's most celebrated sculptor, Giacomo Manzù, has lived and worked in the village of Ardea, about 25 miles south of Rome. On his hilltop, known as the Campo del Fico (Field of the Fig Trees), Manzù lives the life of a conscientious craftsman. Every day he walks across the garden to his studio, which is huge and well-equipped, but a little too cold and clammy for the good of the clay. He spends his mornings working in absorbed concentration. Always, the day's favorite hat—from his collection of about 50—is clamped on his head. Manzù, who is almost completely bald, is seldom seen without a hat, even at meals.

Although he is most widely known for his religious commissions, notably the Doors of Death for St. Peter's in Rome, Manzù (age 64) now concentrates on more secular themes. Among his frequent models these days are his two children, Giulia, 10, and Mileto, 8, their teacher, Beate, and his wife's sister, Sonja. But his favorite model is his German-born wife, Inge. He never tires of portraying her. Currently in his studio he has several heads of Inge in various stages of completion. He is already surrounded by dozens of versions of Inge's face and body in clay, plaster and bronze.

Manzù's dexterity and control of his materials is impressive. In two hour-long sittings he can create a striking likeness in a bust. With a few slaps of his broad hands he can coax a graceful head of Inge from

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In his studio, Manzù begins a portrait of his wife Inge by mashing clay over a wire armature.

The bannerlike form atop the clay head will be a ponytail, supported by an uplifted hand.

Photographs by Dmitri Kessel

a formless blob of clay stuck on a frame of wire and wet newspaper.

"As I put my hands on the clay," Manzù says, "I cannot think of myself as about to produce a work of art. In fact, I cannot think of myself at all. If I entered my studio in the morning, saying I was a master and about to create something great, I'd be in immediate trouble and do nothing.

"For me there is just work and nothing else. Esthetics and intellectual theorizing don't concern me. I never questioned myself about art. I have always worked simply, without examining myself to find out why I made that form instead of another. I have never compiled programs. That must be one reason why I don't like talking—it ends up as just chat."

She sends the chickens flying

Several years before they moved to Ardea, Manzù took Inge into his studio on the outskirts of Rome, piled high with works from a career that then spanned more than 30 years. He said: "They are all yours." In 1966 Inge turned her gift over to a group of friends to be organized as a public museum so that others could enjoy it, too. Situated about a mile from the Campo del Fico, the museum finally opened in 1969. It is housed in a new $800,000 building (pp. 66-67) and contains 67 bronzes, 270 drawings and about 40 gold figurines and medallions, encompassing Manzù's typical themes. The collection is officially known as the Raccolta Amici di Manzù (The Friends of Manzù Collection), named for the group of prominent friends who helped to set it up. The museum is a tax-free foundation, with title of ownership held by a committee, the president of which is Inge.

As one tours the two big wings of the museum, peopled with portraits of Inge and her two children, with cardinals, dancers, lovers and partisans, one has the eerie sensation of reading the artist's private diary, with the author himself peering over one's shoulder, pointing to what he considers important. From the windows visitors can look out onto a garden with still more sculpture. And, happily, there is even an espresso machine and bar for thirsty art-lovers.

In the morning, if Inge is not posing for Manzù, she rushes across the hilltop in her white Mercedes, sending the chickens flying, to practice ballet steps to taped music in her own isolated studio. She spends the afternoon in her office at the museum, dealing with correspondence and checking the visitors on two closed-circuit television monitors near her desk. Keeping records of Manzù's work, exhibitions and publications consumes a great deal of her time.

Manzù was born in 1908 in Bergamo, now a thriving industrial town in northern Italy. He recalls the *mis-*

eria of growing up in a working-class district. The family was oppressively poor. Manzù was one of 14 children, several of whom died in infancy.

His father was a cobbler who worked part-time as sacristan of a small convent. The life of young Giacomo was regulated by the church calendar, for he accompanied his father to the convent and watched him cover the crucifixes and statues with purple draperies during Passiontide, and prepare the altars for Easter and Christmas.

Giacomo was ten when the virulent Spanish flu epidemic swept Italy, shortly after the end of World War I. "All the men of my house were ill, including my father," Manzù recalls, "so they gave me the job of carrying the cross in front of the funeral processions." Before doing this, however, he had to help a priest and nun cover the naked bodies with lime and put them in coffins. "The journey was short and boring, but we did so many trips that, on the way back to get others, I used to fall asleep on the hearse. And I slept peacefully, as children do, not sad or sorrowful, but full of hope. I have always tried to understand disasters in this way, believing in living man, strong and resilient." Manzù maintains that nudity lost all its mystery for him after that early experience.

Not all his memories are so grim. A short train ride up the hill from his home was the old city of Bergamo, a storybook medieval town enclosed in stout walls and filled with richly decorated churches and elegant palaces. There were memories, too, of the composer Gaetano Donizetti and the swashbuckling condottiere Bartolomeo Colleoni, whose family chapel graces the cathedral square.

The first sculpture that Manzù remembers making was the figure of a woman, which he modeled in clay at the age of six or thereabouts. It ended up looking like a mermaid because, as Manzù explains, "I knew

At home, Inge and Manzù, flanked by their children, Mileto and Giulia, enjoy a moment of relaxation.

This view of the museum in Ardea is dominated by a 12-foot-high bronze *Cardinal*, made in 1960.

women had breasts and then a stomach like mine. For the rest, I supposed there was just a tail like a fish."

But days for play and school were cut short by financial necessity. Manzù was sent out to work at the age of 11. "I could have run away from home," he says. "With so many in the family there was just poverty and hunger. What ties could there be to such a background? My mother, perhaps, but only her. I did not run away because they could not manage without my earnings. So I learned how to be a gilder, a varnisher, a plasterer, a stone-mason—any craft to earn one's bread. No one ever taught me how to model or carve. I learned by myself. I found I had a wish to express myself in a certain way. There were certainly no artistic precedents in my family."

Collapsing from hunger in the street

During his years of apprenticeship to various Bergamo artisans, Manzù became a master of materials, learning how to work in wood, stone, stucco and clay. Eventually he began to draw, paint and sculpt. One of his teachers, a stucco-worker, taught him to make plaster friezes and moldings. Manzù thinks his preference for low reliefs, a technique he has since developed in a masterful way, dates from this period. His shallow reliefs (p. 70), partly modeled and partly drawn by incising the clay, are among the most subtle and beautifully realized of his works.

"When I was 14, I bought my first art book," Manzù recalls. It was a monograph on the French sculptor Aristide Maillol. "The first works I saw of his I thought truly modern, enormously important. Now I realize his work is just academic," he adds. "The two artists whose work I really respect are Picasso and Brancusi; these are the great masters."

In 1927, when he was 19, Manzù entered military service and was posted to Verona, a town renowned for its wealth of medieval and Renaissance architecture. Manzù's favorite walk on Sunday afternoons was to San Zeno Maggiore, a 12th-century church celebrated for its spectacular bronze doors, which are decorated with small bronze figures cast almost completely in the round. They seemed to Manzù to be miracles of craftsmanship.

After the death of his mother in 1928, Manzù—determined to be a sculptor—set out for Paris. But he felt uneasy in the art capital of the world. He paid only one visit to the Louvre, did not go at all to the Musée Rodin and never worked up the courage to look up Maillol. Also, he was unable to get a work permit. Eventually his money gave out, and soon afterward he collapsed from hunger in the street. As an impoverished foreigner, he was arrested and unceremoniously expelled from France.

He settled in Milan where he began exhibiting his sculpture, which at that time was partly influenced by antique art, particularly that of the Egyptians, Etruscans and Minoans. Biblical subjects appealed to him because he felt they lent themselves to representation in relief. His frequent use of Biblical themes was not due to strong religious faith but rather to the fact that this was a familiar world for him since childhood.

In 1934 he married a Milanese woman who, over the next five years, bore two daughters and a son. Both daughters died in infancy; Manzù was too poor to obtain the medical care that might have saved them. The marriage did not work out, and Manzù and his wife were legally separated in 1952 with Manzù taking custody of their son Pio, then 13. (Pio, a car designer, died at age 30 in a traffic accident while returning from the opening festivities of the Friends of Manzù Collection.)

In 1937 Manzù had his first one-man show in Rome. It was a success and he began to acquire a reputation in the capital city. The following year he was included

Dance Step, a small bronze of 1965, is one of Manzù's numerous variations on a ballerina theme.

The top leg of these tumbling *Lovers* has raised, crinkled edges caused by casting, which Manzù retains.

in the Venice Biennale, where he showed what he now regards as one of his key works, a sculpture of a crouching *David* (right). Manzù returned to the Venice Biennale in 1948 and walked off with the prize for Italian sculpture. By then he was acquiring an international reputation. The following year he won the commission for what was to become his most famous and arduous work—the pair of bronze doors for St. Peter's. For the next 15 years he worked intermittently and dispiritedly on the doors until, finally, spurred on by Pope John XXIII, he completed them in 1964.

The Doors of Death are, for many people, Manzù's single most important achievement. Situated to the left of St. Peter's main entrance, the doors dramatize the theme of death in ten panels.

"If Pope John had not been there, I would never have made those doors," Manzù says. "At the beginning I had to discuss everything with a commission of cardinals and monsignori—all as old as Methuselah. They only wanted Catholic themes." The original

David, in Manzù's opinion a key work, was made in 1938, when he first showed in the Venice Biennale.

Guantanamera, carved in ebony in 1969, is based on Manzù's recollection of Inge, asleep in a chair.

theme of the doors was The Triumph of the Saints and Martyrs of the Church. But Manzù persuaded Pope John to change the theme to that of death. Since the doors were seldom opened except for funerals, the theme seemed appropriate and the pope agreed.

Pope John had known Manzù's father back in Bergamo in 1906 and remembered the kindness that the elder Manzù had shown to him. The inexperienced young priest was delivering a sermon when, halfway through, he became nervous and started to falter. The elder Manzù tugged at his hem, whispering "Keep going, you're doing fine."

When the time came for Pope John to have an official bust made of him, he chose Manzù. Although they had only 15 meetings in all, while Manzù worked on busts of the pope, a close relationship developed between them. During sittings the Pope spoke to Manzù in the native dialect of Bergamo. The meetings made an overwhelming impression on the sculptor, whose recollections are the subject of an absorbing book, *An Artist and the Pope,* by Curtis Bill Pepper. After John died, Manzù replaced one of the panels on his Doors of Death with a portrait of the pope, who is shown kneeling in a moment of intense prayer.

The person that Manzù reveres most of all is Inge, whom he met in Salzburg in 1954 when he was teaching at the International Summer Academy. One day the director of the academy applied to a local ballet school for a model and a young girl from Munich volunteered. Inge posed in her leotard and Manzù was so taken by her expressive face and lithe figure that the next day he presented her with a single rose (she says it was a bouquet of violets). Since then Inge's finely spaced features, elegant profile and firm chin have been reinterpreted by Manzù in a hundred different ways. She has inspired numerous figures of dancers, from the small bronze "Dance Step" (p. 68) to an 11-foot-high variation for a public fountain in Detroit.

One life-sized nude shows Inge nestling into a modern wing chair (p. 69)—just like the Danish chairs in the lounge in Manzù's home. "One evening Inge and I were sitting here quietly," Manzù explains. "She was in that chair and from time to time she played a record called *Guantanamera* and danced a few steps to it. Seeing her sitting curled up like that, I thought of her nude. The next day I modeled it in six hours without a break, all from imagination. She never posed.

"I work a great deal from memory," adds Manzù. "Even when I use a model, memory intervenes to change, add or deform certain aspects of reality. In that way a sculpture emerges which is sometimes difficult to relate to the model.

"There are a thousand things that inspire me. It can be a face, a sound, a movement, a moment in a season, a phrase, a thought. Then I fix a note on the clay as a writer does on paper. The moment will come when that note can be inserted into a wider picture."

One of the happiest moments in Manzù's life occurred last December when he married Inge in a simple ceremony in Rome's city hall. Following Italy's recent sanctioning of divorce, which enabled Manzù to wed his faithful model and companion of 19 years, Manzù was exultant: "It could happen to anyone! You see a ray of sun coming your way and you want to keep it for the rest of your life."

A mother frolics with her child in *Peace* (1968), one of the low-relief bronzes at which Manzù excels.

Inge appears beside a 1966 bronze portrait of herself. It is part of the museum collection.

By Les Line

Why I became a 'preservationist'

Boyhood frustration, when a village green and a modest river in western Michigan were ravaged, sparked a conservation career

Memories. Of a wild little river. Of a village green.

First, the village green.

The town was Sparta, a pleasant community of 2,000 in the apple and peach country of western Michigan. By New England criteria, its park wasn't much. No long greensward. No ancient elms and oaks. No colonial courthouse or tall-spired church. No granite monuments to Revolutionary War events or heroes. Just a patch of grass enclosed by a spirea hedge on a main street corner. At one end was the requisite bandstand, and next to it a hand-lettered roll of honor for the two World Wars.

My earliest memory from a Midwestern childhood is of sitting on the grass on a summer Saturday evening and listening to Sousa marches being played by a band of high school musicians and alumni. I was proud that the snare drum was the responsibility of my Uncle Fred, and ten years later I contributed the rhythm from the very same place at the back of the band shell.

We marched to the park every Decoration Day to honor our veterans. We gathered there to rejoice when the village fire siren and church bells signaled V-E day and then, four months later, V-J Day. We built autumn bonfires there to cheer our football teams on to championship seasons. And every summer the townsfolk met there after their Saturday night shopping to exchange news and hear some inspiring, if not inspiringly played, music.

Then the village council sold the village green.

They sold it to the town bank so it could build a modern brick-and-glass edifice, complete with drive-in window, on that coveted main street corner. As part of the deal, the village fathers got the old bank for their municipal offices, and some swampy lowland at the outskirts of town for a new park. They built another bandstand there, but few people ever came to the summer concerts again. It was too far to walk, and the mosquitoes were too fierce for sitting on the sparse grass that managed to grow in the dried clay.

On Decoration Day, now, the band and the Scouts and the veterans march to the side of the bank, where a bronze plaque lists in small type the dead of four wars. Taps are played and a wreath left on the sidewalk. And the last time I was home, the Junior Chamber of Commerce held one of Sparta's big summer social events, the annual chicken barbecue, in the parking lot of the bank.

As for the river of my boyhood (a creek or a river is an integral part of growing up in the country), it wasn't particularly distinguished, either. On the map its name was spelled Rogue, but everyone pronounced it Rouge, which is how it appeared on the early records. It was neither red nor a rascal, however. Just a modest river of normal color that twisted for 32 miles through nice, second-growth forest land and tangled bottomland. Even where it sliced through a farm or pasture, its banks were densely wooded.

The Rogue was never so wide that a boy couldn't cast a lure into an eddy behind some tree roots on the opposite bank where a grandfather pike might be lurking. My river abounded in northern pike up to 18 pounds in size, plus native and introduced trout and swarms of spawning suckers when the current warmed up in the spring. To reach the best fishing spots, a boy had to slosh across meadows decorated with wild blue flag and then fight his path through stinging nettles and intertwined willows. Moreover, in those pre-repellent days, one wore mosquito-proof clothing in the hottest midsummer weather.

I almost caught my first fish in the Rogue, but it shook the hook free (and made off with my minnow bait) before my father could position the landing net. I cried. The Rogue would yield my fair share of fish before I left home, however, along with river ducks and, from its woodlands, fat fox squirrels and cottontail rabbits and ruffed grouse and morel mushrooms. And the experience of wildness over a whole boyhood, long before it was possible for the man to visit faraway mountains and canyons and forests and islands and great swamplands where the wilderness was real.

Not that the Rogue was pristine. We always fished north of the outfall from the Sparta sewage treatment plant, for it was obvious to the eye that the sewage wasn't being treated whatsoever. One might bump into a cow more often than a white-tailed deer, and there usually was a road within earshot. Still, it was a shock and an outrage that summer when the draglines moved in and began systematically to destroy the northern and wildest one-third of the river.

The project was simply make-work for the county drain commissioners, but it was done with all the zeal of the channelization schemes of the Soil Conservation Service and the U.S. Army Corps of Engineers. The circuitous Rogue was routed straight as a gutter, its banks stripped of all vegetation, its bottom gouged of anything that might conceal or nourish a fish.

The cause for such ruination was never explained. Presumably flood control was the excuse. The Rogue would escape its banks during the spring freshets and a few cows might be stranded for a day or two on high ground. But the nearby farms were mostly hardscrabble and, indeed, much of the channelization took place in the middle of a state forest preserve.

The last time I was home, the local newspapers announced a grand plan by county officials to dam the Rogue River and flood the wild parts that were still left. They want to create a big, long lake for waterskiers and motorboaters. This in a glacier-sculpted county that is already chockablock with natural lakes of all shapes and sizes.

I suppose it was inevitable.

I recite these stories not because they are unique (although how many village greens have been sold to banks?) but because I have often been asked what

This bank replaced the village green in Sparta, Michigan, the author's hometown. In return, the town was given some swampy land nearby (below), which never seemed to catch on as a park.

A preservationist

led me to a career in conservation. The answer, I believe, lies in those two incidents from my boyhood.

When the village council quietly sold the town park, no voices were raised in protest. To a 14-year-old, it seemed the wrong thing to do. It seemed terribly wrong, not long thereafter, when a little river was ravaged. But I could only watch in frustration as the bandstand was ripped down and as the steam shovels ground onward. There was a feeling of utter helplessness—and the hope that, one day, I could do more than anguish at such iniquities.

I grew up in a day when conservation meant the propagation of creatures for the hunter's bag, the trapper's line, the fisherman's creel and not the saving of village greens and country rivers. Indeed, up to a very few years ago those of us who tried to stop the despoilers (whether they were great bureaucracies and industries or merely local drain commissioners and bankers) were simply ignored, as a boy in Michigan tried to ignore the Rogue River mosquitoes.

Mosquitoes, however, demand man's respect. Now a new breed of conservationist has developed a bite that despoilers should respect. Instead, they have chosen to swat. They spend their public relations dollars trying to create an "environmental backlash." They have fought back by calling names and throwing stones. Wilderness advocates have been labeled "woodsy witch doctors of a revived nature cult" by a spokesman for the timber industry. These "modern Druids," he explains, "would sacrifice jobs and fulfillment of human needs . . . in order to achieve their own selfish goals." In a few cases developers have hurled multimillion-dollar lawsuits against citizens who testified against housing projects at public hearings.

A popular epithet is "preservationist." It is used liberally to label those who insist on sane national policies and priorities and restraints on such matters as oil exploitation, highway construction, pesticide spraying, mining, logging, land development, powerplant siting, the building of airports, the damming and straightening of rivers, the pollution of air and water, the commercialization of wildlife, the poisoning of predatory animals. It has even been used by old-line conservation clubs to disparage their nonhunting colleagues who would curtail open seasons and bag limits to aid dwindling game species, or end unsportsmanlike shooting practices.

Indeed, preservationist has replaced "little old lady bird watcher" as the favored pejorative, since the latter term hardly applies to today's broad-based environmental movement.

The despoilers, I suggest, should consult their dictionary. There they would find preservationist defined as "one that advocates the preservation of a species from extinction," a cause that hardly seems so despicable.

Man, they tend to forget, is also a species. The saving of brown pelicans and prairie dogs and butterflies, the protection of native rivers and great swamps and untrammeled wilderness, the opposition to the ravishing of the land and the poisoning of the ecosystem—all have as their ultimate goal the preservation of a meaningful life for the human species.

I am proud to be called a preservationist.

Les Line, editor of Audubon *magazine, is one of the nation's strongest environmental advocates. He adapted this article from his introduction to* What We Save Now, *to be published soon by Houghton Mifflin.*

FRED and BARNEY drive the INTERSTATES

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"Witches' cradle" at Maimonides center twirls subjects to alter sensory perception prior to ESP testing.

By Paul O'Neil

Science ponders the ESP mystery

Armed with new respectability and well-tried lab techniques, parapsychologists prove the human mind knows more than it lets on

Parapsychology, the science which explores extrasensory perception (ESP), is achieving respectability after years of criticism from members of older disciplines. Since J.B. Rhine, considered the father of parapsychology, carried out his early studies at Harvard and and Duke in the 1920s and 30s, his subject has gained acceptance in ever-widening circles. Seventy-seven U.S. colleges offer courses in it. Two-and-a-half years ago, astronaut Edgar Mitchell conducted the first ESP test from deep in space during the Apollo 14 mission. He had definite evidence of ESP, according to Dr. Rhine. Mitchell has formed an organization to raise funds for further study.

The American Association for the Advancement of Science has admitted the Parapsychological Association as an affiliate, and the National Institute of Mental Health has made a major grant ($50,000) to Maimonides Hospital in Brooklyn for the Division of Parapsychology and Psychophysics.

Academic acceptance springs in part from the parapsychologists' inventiveness in thinking up new and more accurate ways to test ESP phenomena. Investigators now offer statistical evidence of three different types of ESP: clairvoyance (the ability to see, hear, smell or touch real objects or true events which are not present to the senses), telepathy (mind-to-mind communication), and precognition (knowing something before it happens). Another psychic power is psychokinesis, the ability to influence inanimate objects by non-physical means.

One aspect of parapsychology being investigated at some centers is the out-of-body experience, in which a person claims his mind has physically left his body and gone to another location. Although people usually report having had this experience spontaneously, a few psychics claim to be able to make their minds leave their bodies at will. Out-of-body experiences may sound preposterous to most people, but researchers have turned up witnesses who say they felt a presence or saw a person at the precise time and place that the "mind" was supposed to have visited.

Few test results exceed the probabilities of chance by more than small margins. Researchers don't levitate tables or produce ghosts anymore. But new laboratory work suggests dilemmas for conventional science. Either there were flaws in modern statistical concepts, or accepted principles of physics can no longer fully explain our world.

Experiments which provide today's statistical evidence of ESP rule out any such easy and mechanical explanation as electrical impulses. The scientist is left to speculate (for lack of any other theory) that ESP utilizes some kind of "mind force." ESP seems to work better when the receiver is in a state of altered consciousness such as relaxation, sleep, hypnosis or the alert but unfocused state that produces the so-called beta-wave brain pattern.

Says Dr. Rhine: "We haven't found that certain personality types have more ESP than others, but we find there are qualities common to people who do best in the tests. Anybody who is extremely efficient, organized, logical, mathematically minded, who reasons everything out, is on time all of the time, always in control of himself, wouldn't show much of it. If he did show it, it might be negative. His wife, who may be a bit frivolous, not very prompt, not very logical, might sit down and get a good score compared to his."

Also, people's attitudes toward ESP and toward participating in ESP experiments have been found to influence their ESP performance. Gertrude Schmeidler, a psychologist, found that believers tend to score higher than skeptics. She categorized the believers as sheep and the non-believers as goats, and found that the sheep scored above chance while the goats scored below. This has been corroborated frequently.

Other studies have suggested that sometimes the worst scorers tried hardest, but seemed too uptight for any ESP ability to function. Those who were relaxed and having fun participating—even though they didn't necessarily believe in ESP—scored well.

Paul O'Neil was long a writer for Time Inc. magazines, covering such stories as Britain's "Great Train Robbery" and the Onassis wedding. He is now writing one of the Old West series for Time-Life Books.

Sleeping subject, wired to reveal dreaming phase, is sent a telepathic picture, hopefully to dream of.

If most people have ESP abilities, as many parapsychologists maintain, why don't more of us show them? Dr. Karlis Osis of the American Society for Psychical Research in New York City says, "We have been culturally conditioned to shut out our depth forces. We have been taught to impress, to fake certain behavior in order to obtain certain goals."

Psychokinesis and ESP together are called psi. Tests have led to an odd concept known as "psi missing"—based on the fact that people who do not respond *positively* to ESP more often than chance would dictate, are apt to react more *negatively* than would be probable by free choice. They could not do so, in theory, if there were no force present to be resisted.

Hundreds of people claim to have *known* that President Kennedy would be killed in Dallas; some of them said so ahead of time, before witnesses. Folklore is full of such reports of precognition by wives who warned husbands not to go into the mine, by mothers who dreamed that sons would be killed in battle. It is almost impossible to demonstrate that such premonitions are not just guesswork. But experiments at North Carolina's Institute for Parapsychology—founded by Rhine—would seem to prove that both men and animals *can* foresee the future in varying degrees.

One test allows a subject to predict, by punching a button, which one of four electric bulbs will be lighted through random escape of electrons from a radioactive source. For Helmut Schmidt, a physicist at the North Carolina Institute of Parapsychology, a group of three people scored 1.1 percent higher than chance; they did

so many tests that the odds are 10 billion to one against their doing so well by simple luck. A mouse or a gerbil was able to beat the odds in predicting (by hopping away) which section of his cage would be randomly charged with weak electricity once a minute.

Back in the 1940s, two British psychic researchers, S. G. Soal and K. M. Goldney, found ESP subjects able to "see into the future" in card-guessing tests—at least a few seconds ahead. They got ahead of the tester and guessed the next card, or even the second one ahead if the process were speeded up.

No aspect of ESP is so hard for the layman to accept as the idea that the mind may move inanimate objects

Buttons light when activated by the random decay of strontium 90. Subject guesses which light will come on.

(psychokinesis or PK) or even project itself so it can observe things at a distance (out-of-body). Experimenters offer proof that falling dice can be minutely deflected by mind power. Ingo Swann, a New York artist, intrigued a group of Stanford University physicists last summer by apparently altering the performance of a deeply buried, heavily shielded magnetometer for 30-second periods through use of PK, and by then "looking into" the device and describing its mechanism.

Some people are more naturally talented in the exercise of ESP than others. But the ability to communicate by extrasensory means seems to depend so markedly on mood, receptiveness and a kind of intellectual freshness (even the best subjects show a "decline" in performance after many repetitions) that failure is very often a temporary phenomenon. "Believers" tend to score higher above chance than the uninterested. As the research goes on and more is learned about the necessary conditions for psi, it is likely that a subject can keep on the positive side, or score high, most of the time. According to parapsychologists, a person who is violently critical of parapsychological theory—who believes the whole subject is utter nonsense—may score dramatically below chance, thus proving by the theory of "psi missing" that he is capable of ESP anyhow.

Using psychokinesis, this subject has changed the temperature reading inside a wrapped thermos.

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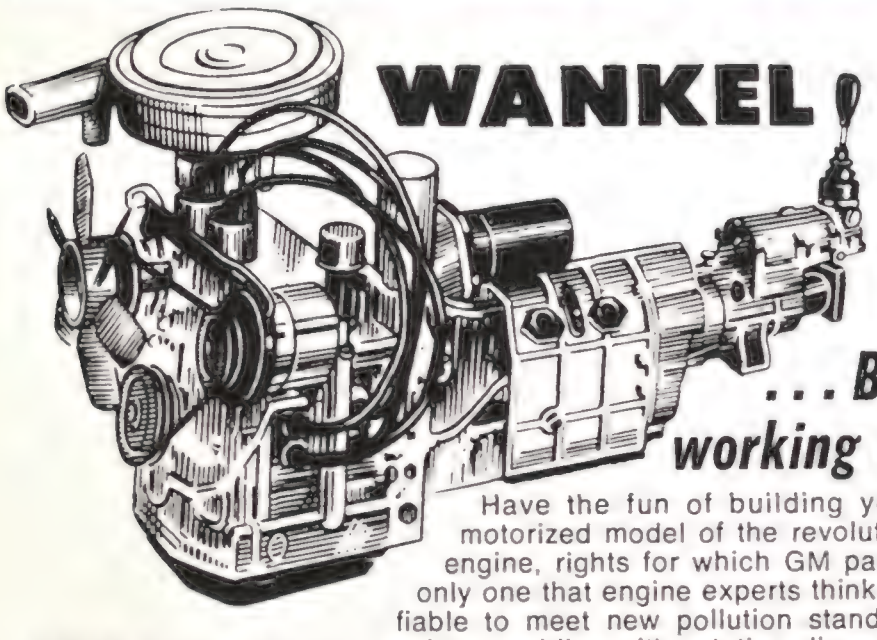

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Find the four aces and lay them, face up, in a row. Pick up the top one of the 20 test cards without looking at it and place it, still face down, beside the ace which, in your opinion, matches its suit.

After all 20 cards are dealt, turn over the four piles and add up your score. Then reshuffle and repeat the process four more times—or until you complete 100 match-ups with your aces.

You should be able to make 25 correct choices simply through the dictates of chance. But the odds are 100 to 1 against your being able to make as many as 37

correct choices or, negatively, as few as 13. The odds are 1,000 to 1 against your getting as many as 40 or as few as 10 by chance alone.

PRECOGNITION: This test needs only a sheet of paper, a pencil and the telephone book. Write down a column of 100 random digits between 0 and 9 out of your head. Have someone else open the phone book at random and, starting from the left-hand page, read aloud the last digit of 100 telephone numbers.

These final digits are valid substitutes for the tables of random numbers used in laboratories. Write them opposite the column of 100 numbers you have predicted. One in ten should match by chance. The odds against your matching 15 are 100 to 1. The odds are 1,000 to 1 against your matching 19.

TELEPATHY: This experiment also needs two people, a sender and a receiver. It requires five cards of each suit. The receiver retreats to a room out of sight of the sender, who shuffles the 20 cards and deals them, face up, one by one. He signals each time he deals by stamping on the floor. He also tries to "tell" the receiver with his mind the suit of each card as it is dealt.

The receiver keeps a numbered list of his choices, writing down heart, club, spade or diamond after each thump. After every 20 deals his list should be scored against the sender's stack of cards. The test should continue until 100 choices have been made.

Of course the receiver may actually be using clairvoyance to pick the suits. However, his results are scored as in test number one. Chance dictates that he should make 25 correct choices out of 100. The odds against his choosing more or fewer correct suits are the same as they were in the first test.

PSYCHOKINESIS: Put a nickle in a can or other container with a mouth that can be covered with the palm of one hand. Shake the coin vigorously for at least five seconds before allowing it to drop out on the table or floor.

Try 25 shakes while you are concentrating on making the coin turn up heads, then 25 more while trying your hardest to induce tails.

Repeat both of these 25-shake trials, thus achieving a total of 100 shakes. Keep a record of the times the coin obeys your will. Chance dictates that it will turn up the way you will it 50 times. The odds are 100 to 1 against achieving 63, or negatively 37, of these mind-induced performances and 1,000 to 1 against 67, or negatively 33, successes in your attempts at mind over matter.

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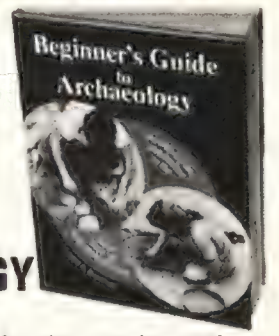

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Book reviews

Bell: Alexander Graham Bell and the Conquest of Solitude
Robert V. Bruce
(Little, Brown, $12.50)

This book is apt to be regarded for many years as the definitive work on the man whose great invention was, of course, the telephone. Bell's biography should be of particular interest to SMITHSONIAN readers because Bell was, among other things, a Smithsonian regent. He was a friend of both Joseph Henry and Samuel P. Langley and he played a decisive role in persuading the other regents to accept the great art collection of Charles L. Freer. In addition, he either founded or sustained at critical junctures such well-known publications as the *Volta Review, National Geographic* and *Science*.

Author Bruce is the first of the biographers to be given unrestricted access to the Bell papers. He assures us that he was given a "completely free hand" in his selection of evidence and in the conclusions reached. The book is well illustrated and thoroughly documented. It is one of the comparatively rare biographies of a scientist or inventor that not only satisfies the standards of the professional historian but can be read with enjoyment by a much wider audience.

The book is divided into three major parts. The first section examines Bell's Scottish heritage with a focus on his lifetime interest in education of the deaf. The second section is devoted to the conception, birth and early infancy of the telephone in the 1870s. Bruce gives a plausible explanation of why such a seemingly simple device was not invented much earlier. The telephone is seen as resulting from a convergence of several strands of 19th-century science and technology. Bruce stresses, however, that it was chance that brought the young man with exceptional experience in the mechanics of speech and hearing to Boston, which "provided the proper intellectual, technical, and economic environment for the invention of the telephone."

The last section considers Bell's activities after severing his nonfinancial involvement with the telephone industry. Paradoxically, the very assets which had led to his great invention seem to have become liabilities in his later investigations in such fields as aeronautics, hydrofoil boats and sheep breeding. He was perhaps most effective as a patron and popularizer of scientific research.

Bruce has not chosen to dwell on the sociocultural impact of the telephone. But as a skillful narrative that provides information about and insight into Bell's personality and career, the book is impressive.

—James E. Brittain
Associate Professor,
Georgia Institute of Technology

Pitcairn: Children of Mutiny
Ian M. Ball
(Little, Brown, $8.95)

"A sea-going disaster, begotten in a galley, and born under a gun! His hair was rope, his teeth were marlin spikes. . . ." So was William Bligh described in an MGM publicity release for the 1935 film, *Mutiny on the Bounty*. And who can forget Charles Laughton as the tyrannical and abusive Captain Bligh, jowls aquiver with rage as he is ordered into the ship's boat by long-suffering Clark Gable as Fletcher Christian?

Can this be the same William Bligh who was James Cook's sailing master during the great explorer's last voyage? The Bligh recommended for command of the *Bounty* by Sir Joseph Banks, president of the Royal Society? The officer who fought at Dogger Bank, Camperdown and Copenhagen, receiving personal commendation from Lord Nelson for his conduct? It hardly seems possible.

But Bligh the bully he has become, through a process of defamation which began during his own lifetime. The smear, first applied by Fletcher Christian's pamphleteering brother, later perpetuated by Nordhoff and Hall's *Bounty* trilogy, has been so complete that "Bligh" nearly rivals Jean Martinet or Simon Legree as a term of opprobrium.

In *Pitcairn: Children of Mutiny,* the Australian-born, New York-based author Ian Ball has treated the mutiny and its aftermath with two objectives in mind: first, the vindication of Bligh; second, an understanding of the history and current situation of the people of Pitcairn, the descendants of those few mutineers and Polynesian men and women who, on January 23, 1790, burned their ship beneath the cliffs of that lonely island.

Ball, for the defense, makes it clear that the real villain of the mutiny was Tahiti itself. The mutineers just couldn't bear to go back to England after more than five months in what must have seemed to them the only real paradise they would ever know.

Brenda Christian at Bounty Bay: Did her great-great-great-great-great-grandmother help inspire the mutiny?

The description of the subsequent history of the mutineers and their descendants makes fascinating reading. The tiny colony somehow managed to survive to become an established, deeply religious community. Life was precarious; twice the islanders left, but they came back.

His picture of Pitcairn today is equally bleak. The young move away to the manufacturing centers of the Pacific. At the beginning of 1972, the population

was just 85. Ships, the islanders' principal source of supplies and income, stop less frequently.

About the ancient crimes upon which their microculture was founded, the islanders know or worry little. Still, some almost hereditary guilt remains, revealed in the first verse of an island hymn:

To this fair land our fathers sought / To flee their doom their sins had brought, / In vain—nor peace nor rest was found, / For strife possessed th' unhallowed ground.

—Alexis Doster III
Assistant Curator, National Air and Space Museum, student of naval history

The Eternal Bliss Machine
Marcia Seligson
(Morrow, $7.95)

The premise of this entertaining slice of Americana arises bluntly in the book's first sentence: "There is something hilarious about weddings. . . ." Marcia Seligson, a journalist turned amateur sociologist, has crisscrossed the country observing weddings of every sort, of all ethnic and economic varieties. She documents her premise with often spectacular details.

Imagine, for example, a Long Island wedding in which the bride appears on a seven-foot-high revolving pedestal, bathed in colored lights. The pedestal is no whim of the bride's, but a standard feature of an assembly-line catering operation which performs about 20 such weddings every weekend. Or how about weddings on roller skates or water skis, or in cemeteries, swimming pools, airplanes or thin air (the parachuting bride wore "white leather jump boots, a white crash helmet, and white satin overalls")? Consider, too, the classic Las Vegas wedding: It takes only a few minutes, and the price includes a free pizza and a roll of nickels at a neighboring casino.

Nor does a decorously conventional wedding look any less fantastic when examined under the author's sarcastic microscope. A nice proper church ceremony emerges as a logistical nightmare, a gauntlet of pedantic regulations. Only a professional consultant can tell you whether the guest book should be signed at the church or at the reception, or when the bride should toss the bouquet, or whether the telegrams should be read by the best man.

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- ☐ Why should you be careful about shipping things back from Africa?
- ☐ What 10 things should you be absolutely sure to check before renting a villa abroad?
- ☐ If an airline cancels your flight and tries to put you on one several hours later, what's the first thing you should do?
- ☐ What cardinal rule do most knowledgeable travelers observe when ordering bottled water abroad?
- ☐ Why do experienced travelers check their credit cards after returning from abroad?
- ☐ What basic rule do experienced travelers observe before checking in their luggage on a flight?
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- ☐ In flying from the U. S. to Australia, what's the worst mistake you can make?

Not mistakes—*but do you know . . .*

What's currently the most exciting archeological dig in the Greek Islands? Why does your travel agent so often send you to that big chain hotel when what you really wanted was that "charming little inn"? What are the fashionable thoroughbred race tracks in Paris? What are 15 of the world's big game fishing spots? Where are Denmark's most attractive country inns? How do you go about arranging a golf game at a Japanese club? Is a trip up the Rhine really worth it?

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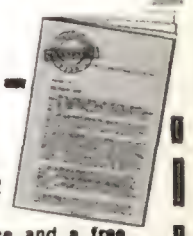

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Study tours are designed as educational travel for members of the Smithsonian Associates. Smithsonian staff or other experts accompany tours. See below.

Foreign Study Tours

For information: Miss Bliss Schumann, Room 123 SI, Smithsonian Institution, Washington, D.C. 20560.

African Safari and the Seychelles: Tanzania and Kenya game parks, plus the Seychelles in the Indian Ocean—July 17-August 7 (waiting list only).

Mexico and Guatemala: Historic sites of Yucatán, Oaxaca, Mexico City, Tikal and Antigua (depart and return Miami)—August 27-September 14.

Aerospace Museums: A nontechnical tour of these special museums in Munich, Lucerne, Moscow and London—September 17-October 3.

Copernicus: Polish and Italian cities where Copernicus lived and worked, including Krakow, Frombork, Torun, Warsaw, Bologna and Padua—October 1-21.

West Africa: Historic sites from Mali to Senegal—January 8-February 1, 1974.

India and Nepal: Emphasis on architecture and museums—January 18-February 10, 1974 .

Sites of Civilization: Cruise from Rome to Athens—April 6-27, 1974.

Greece: A tour of sites and flowers on the mainland and Peloponnesus—April 27-May 12, 1974.

Ethiopia and Kenya: Ancient and contemporary cultures from Aksum to Lalibela, plus several days in Kenya—May 23-June 14, 1974.

Black Sea Cruise: Depart and return Athens—September 17-October 6, 1974.

Afghanistan and Pakistan: Archaeological and historical sites—October 21-November 11, 1974.

Domestic Study Tours

For information: Mrs. Patricia Kilkenny, Room 106 SI, Smithsonian Institution, Washington, D.C. 20560.

Alaska Float Trip and Cruise through Prince William Sound: July 18-August 1 (waiting list only).

Archaeology Dig: Participate on a working project in Concord, New Hampshire —weeks of August 5 and 12. Students only—week of August 19.

Acadia National Park, Maine: Experience the craggy shores and rugged cliffs of this New England national park—September 9-15.

California Colonial History: Explore the architecture and history of Hispanic California from Los Angeles to San Francisco, including the missions, Morro Bay and Monterey—September 16-23.

Sea and Shore Laboratory, Charlotte Harbor, Florida: Using the facilities of the Mote Marine Lab, participate in ongoing research problems concerning birds and shallow-water animals—October 11-18.

Big Cypress Swamp and Everglades National Park: Explore and learn the natural history of these regions in southern Florida—November 11-18.

Louisiana Plantation Architecture: Tour the historic and unique architecture of southern Louisiana—November.

Christmas at the Smithsonian: Enjoy a weekend of cultural activities and Christmas tradition at the Smithsonian—December 7-9.

There is more to *The Eternal Bliss Machine* than a procession of anecdotes, however. The author goes on to ask why our marriage ceremonies, in spite of their incredible variety, share a common tone of frantic excess. Why, in this supposedly skeptical age, do most Americans insist on a formal wedding, and spend some seven billion dollars a year at it?

Because, the answer goes, a wedding is an ideal vehicle for "our two paramount, lifelong concerns as a people—love and money." By marrying its offspring in the most extravagant manner possible, a family has a golden opportunity to exhibit its powers of conspicuous consumption, and thus to refine its social status. According to popular mythology, a woman's wedding day is the high point of her life, the culmination of her existence, the one great romantic moment for which she is told to prepare from childhood on. Women's Lib has a long way to go.

Readers who find these conclusions disagreeable can easily object to them on the grounds that *The Eternal Bliss Machine* is unscholarly. Ms. Seligson has a cavalier approach to facts and figures. Still, her arguments are thought-provoking, and the book is by no means a diatribe against weddings. The author confesses that, no matter how silly the circumstances, the sight of a bride marching up an aisle can bring a tear to her eye.
—Madeleine Lundberg
Author of two SMITHSONIAN articles,
twice married in civil ceremonies

A Bevy of Beasts
Gerald Durrell
(Simon and Schuster, $7.95)

Twenty years ago, I am horrified to realize, I reviewed Gerald Durrell's first book, *The Overloaded Ark*. I loved it.

"This should become the type specimen for the small-adventures-with-nature book," I wrote then, "type specimen" being the biologists' term for the true exemplar of a given species, the one against which all others are measured to see if they are genuine.

It was a great success, and deservedly so. It was an account of an animal-collecting trip into the Cameroons, keenly observed, well written, chock-full of information and wit. *The Overloaded Ark* was written to boil the pot. The Durrells needed the money; they got it. Lately,

since Durrell runs his own zoo (SMITHSONIAN, September 1972), the books include a straight-out appeal for donations.

Durrell has produced a book just about every year; I count 16 by him and one by his wife. Both Durrells have on occasion a failing for what Mrs. Durrell rightly calls "schoolboy humor" and a distressing delight in cuteness.

But by and large it is a remarkable series of good books, with some particular triumphs (*My Family and Other Animals* among them). It is a pleasure to report that the 1973 Durrell, which concerns the year when he was 20 and worked as a student keeper in the Whipsnade Zoo, a "country zoo" 30 miles north of London, is, if not among the very best, certainly among the very good.

Two aspects of a tale seem to bring out the best in Durrell. The first is nostalgia, as in the books about growing up on the island of Corfu. The second, oddly, is that although he draws animals about as well as any writer going, he does even better with human characters.

The nostalgia works for him in *A Bevy of Beasts,* and the Durrell eye is on the people, too, particularly the zoo's head man, who cooks "incandescent" curries and saves gasoline by turning off the automobile engine when going downhill, forcing his passengers to "bob" the car along like a bobsled team.

But the book moves rapidly around the zoo, and none of the human characters is on stage long enough to be fully explored —or at least not long enough to suit me. (One who is immortalized in a line is a small boy who watches the tigers being fed and asks Durrell, "Mister, 'ave you ever been ate by one of them buggers?")

—Frank Sartwell
Free-lance writer and occasional contributor to SMITHSONIAN

The Man Who Invented Baseball
Harold Peterson
(Scribner's, $7.95)

No, it wasn't Abner Doubleday, as most sports fans know. Harold Peterson has a legend-shattering rejoinder to generations who've believed the Mills Commission report, issued in 1907, on the beginnings of baseball. While developing an article, the author, a *Sports Illustrated* reporter, came upon a number of vague references to one Alexander Cartwright. After further investigation, he uncovered a cache of information that goes a long way toward proving that Cartwright—a robust, 19th-century bon vivant—was the man who invented, or at least formulated and codified, the rules of modern baseball.

He presents the case for Cartwright in this new book, which focuses as much upon mid-19th-century American history—and the history of New York City—as it does on the diamond sport. For after seeing the game come alive with his regulations on the playing fields of lower Manhattan and nearby Hoboken, Cartwright was stricken with gold fever and, in 1849, headed westward. Throughout his trek to California, and beyond to Hawaii, he preached the gospel of baseball; perhaps as a result, the sport is as much a national pastime in the 50th state as it is in the original 13.

Peterson draws a bead on written evidence of baseball's existence over the centuries, ranging from an 18th-century German sports book and *Pilgrim's Progress* to a 20th-century anthropological expedition harking back to the Stone Age.

As a book about baseball, it is one of the half-dozen best sources available on the subject.

—Michael J. Bandler
Free-lance literary commentator

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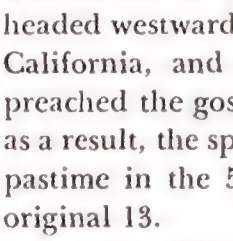

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Smithsonian highlights

Division of Performing Arts
The seventh annual Festival of American Folklife is being held from June 30 through July 8 in the area around the Reflecting Pool between the Lincoln Memorial and the Washington Monument. The festival features singers, musicians and craftsmen from Kentucky; dancers and musicians from Yugoslavia and Serbo-Croatian communities throughout the United States; carpenters, bricklayers and skilled workers from the nation's building trades; and American Indian craftsmen and dancers from the Northern Plains. Native foods and refreshments are available. No admission fee.

"Alice in Wonderland" continues at the puppet theater, Arts and Industries Building. Performances are at 11 A.M., 1 and 2 P.M., Wednesday through Sunday. For tickets, call (202) 381-5395.

Parking on the Mall
Metro construction has made parking on the Mall near the Smithsonian complex extremely difficult. All parking prior to 10 A.M. is restricted. The use of fringe parking areas and/or public transportation is recommended whenever possible. Current parking information may be obtained by writing to the Smithsonian Associates' Reception Center.

Smithsonian Commons
Luncheon facilities for members of the Smithsonian Associates are in the original Smithsonian Building. Open Monday through Friday from 11:30 A.M. to 2 P.M., the Commons offers a buffet luncheon from $1.40 to $1.85 upon presentation of an Associate Membership card.

National Collection of Fine Arts
"A Measure of Beauty: The Diffusion of Style in Early 19th-century America" is a collection of 19th-century objects, including prints, drawings, watercolors, bandboxes, books and miniatures—opens July 6.

"Women Artists in America" is the subject of a lecture by Professor William H. Gerdts of Brooklyn College—July 26, 12 noon in the Lecture Hall.

Renwick Gallery
"Form and Fire: Natzler Ceramics 1939-1972" is a collection of 100 pieces by Gertrude and Otto Natzler, who are known for a combination of simplicity and perfection in their ceramics—opens July 27.

National Portrait Gallery
"The Black Presence in the Era of the American Revolution, 1770-1800" is a major exhibition of 250 items, including portraits, prints, broadsides, petitions, poems and letters which demonstrate the influence of blacks in the founding of this country—opens July 4.

Freer Gallery of Art
"Ukiyo-e" is a special exhibition of this unique, 16th-century school of Japanese painting. Including more than 100 paintings, it is the first of three shows planned to commemorate the 50th anniversary of the Freer.

Contributing Memberships

Persons who contribute $50 or more annually to the Associates support the Institution's national educational programs and enjoy additional privileges. Graduated benefits include:

- Assistance in communicating with any part of the Smithsonian.
- Information on any museum in the world in advance of a visit there.
- Smithsonian annual report and other publications.
- Invitations (when in Washington) to exhibition previews and special events, including admission of a guest.
- Research service for questions about subjects related to the Smithsonian.
- A remembrance from the Smithsonian in the form of a commemorative object or work of art. Write: Contributing Membership, Smithsonian Associates, Smithsonian Institution, SI 118, Washington, D.C. 20560.

National Air and Space Museum, Arts and Industries Building
NASA Skylab Mission: A special exhibit in the West Hall includes television coverage and live audio during manned flight operations.

Bonestell Space Paintings: The first public showing of Chesley Bonestell's 27 oil paintings commissioned for Arthur Clarke's book, *Beyond Jupiter,* continues through Labor Day.

"Exhibition Flying" is represented by the barnstorming Waco 9; the racing Turner RT-14; the Pitts Special, used recently in the World Aerobatic Championships; and a replica of the air show grandstand with continuous films of the internationally acclaimed National Aerobatic Championship team.

Museum of Natural History
"Synthetic Crystals" is a comprehensive survey of man-made crystals, showing how they are made, what they are used for and how they differ from natural crystals (See June SMITHSONIAN).

Live ants, cockroaches, termites and spiders are among the delights of the Smithsonian "Insect Zoo." Visitors can observe biological aspects of these insects in natural, environmental settings.

Museum of History and Technology
The Henry R. Luce Hall of News Reporting features an audiovisual chronicle of the colorful history, important personalities and technological advances of American journalism.

Associates' Events
Walking Tours of Capitol Hill and other Washington areas noted for their distinct architecture are planned for July. Other events include a performance by the New York Light Ensemble; a trip to historic Wayside Inn, Virginia; tours of the Washington Cathedral; and basketry and embroidery workshops. For information, call (202) 381-5157.

Museum Summer Hours
Four Smithsonian museum buildings will be open from 10 A.M. to 9 P.M. each day through September 3. Included in this schedule are the History and Technology, Natural History, Arts and Industries and Air and Space buildings.

Museum Reference Service
The Smithsonian Associates' Museum Reference Service is available to members traveling within the United States. Associates may write for a packet comprised of lists, by state, of many of our country's museums, galleries and historical sites. Brochures are included when available. Please specify the states in which you will be traveling. Allow three weeks for mailing. Write: Smithsonian Associates' Museum Reference Service, Associates' Reception Center, Smithsonian Institution, Washington, D.C. 20560.

Traveling Exhibition Service
There are up to 70 different Smithsonian-sponsored exhibitions on display each month throughout the United States and Canada. For a complete listing and information on how to bring an exhibit to your area, write: Traveling Exhibition Service, Smithsonian Institution, Washington, D.C. 20560.

- Charleston, W. Va.—"Paintings by Edwin Scott" (Charleston Art Gallery, July 7-Aug. 5).
- Fort Wayne, Ind.—"Eskimo Art" (Fort Wayne Museum of Art, July 7-Aug. 5).
- Midland, Texas—"American Pieced Quilts (II)" (Museum of the Southwest, July 7-Aug. 5).
- Salinas, Calif.—"The Simple Home: Domestic Architecture in the San Francisco Bay Region" (Monterey Savings and Loan Association, July 7-Aug. 5).
- Davenport, Iowa—"Mississippi Folk Architecture" (Davenport Museum, July 7-Aug. 5).
- Rhinelander, Wis.—"Early Chicago Architecture" (Nicolet College and Technical Institute, July 14-Aug. 12).
- Pine Bluff, Ark.—"Just Before the War (I)" (Southeast Arkansas Arts and Science Center, July 14-Aug. 12).

Smithsonian Speakers
The National Speakers Bureau is a service provided by Smithsonian Associates which offers an opportunity for organizations within the United States to request curators and other Smithsonian staff members to lecture on a wide spectrum of disciplines. Travel and other expenses are paid by participating organizations. Write: National Speakers Bureau, Smithsonian Associates, Smithsonian Institution, SI 118, Washington, D.C. 20560.

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By Patrick Ryan

The sad state of revolutions

In this commemorative month when all red-blooded Americans celebrate their release from the tyranny of the British, and the British, as things have turned out, breathe sighs of relief that the Americans made it, I feel it timely to declare my allegiances: I am a staunch supporter of the American Revolution.

My liberal fervor reaches a frenzy on Independence Day—possibly because, wherever I may have happened to be on various Glorious Fourths, all the booze and bonhomie that the human frame could absorb were always available at American embassies, business houses or army units. My only criticism is that the military celebrations sometimes went on until July 6.

The only nation in which the Fourth of July is greeted with comparable vehemence is Denmark. Early in this century Danish-born Americans, back for a visit, began holding celebrations on the Fourth to honor their two homelands. The experience of spending Independence Day in Rebild Park with mixed parties of exultant Americans and Danes can leave a sensitive Briton schizophrenic as well as hung over.

Revolutions ain't what they used to be. Those who now burn to overturn the status quo don't seem to have the style of their predecessors. Perhaps technological progress has reduced the opportunities for carrying on with panache. Since denim pants and fatigue jackets became the uniform of dissent, there has been little about it to attract artists—certainly nothing like the days when Bostonians dressed up as Indians before sallying forth to toss tea into the harbor. Delacroix was lucky to have been wielding his brush when the barricades were manned in full costume or, as in the case of *Liberty Leading the People,* by topless ladies.

Few splendid flags fly over the vanguards of revolution today. Where once the "Marseillaise" hypnotized multitudes, all we now have to lure us on to the streets are plaintive dirges chanted to the twanging of weary guitars. And where has all the rhetoric gone? "Give me liberty or give me death!" seems now to be replaced by "Like, do your own thing, man."

The current paucity of verbal and visual flair may be due to the fact that whereas revolutions were once the passion of those with intellect, they are now the province of those with weapons. Overthrows of resident authority, particularly in volatile or emergent nations, are becoming the monopoly of the armed forces. Those who already possess the practical means of power do not need the inspiration of intellectuals. Fresh loyalty to a new regime is more swiftly fostered at gunpoint than by oratory. "Revolutions," said Bernard Shaw, "have never lightened the burden of tyranny; they have only shifted it to another shoulder."

But let not any somber observations intrude upon the celebration of the day when Americans threw off the foreign yoke to replace it with one of their own making. It is a long tradition that they are keeping green. The first revolution against established authority was perhaps that of Lucifer and his Fallen Angels, followed by Eve with her apple.

Long may the celebration of the Fourth of July flourish—until Women's Lib finally wins out. Then Independence Day will be labeled a male chauvinist trick, since there was no woman's signature on the Declaration of Independence. The document will be re-signed by leading American ladies, Gloria Steinem will ride from Charlestown to Lexington, Betty Friedan will challenge any male to beat her up Bunker Hill and Germaine Greer, dressed up as a squaw, will toss Norman Mailer into Boston Harbor.

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